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REPORT

Site-Wide Work Plan

68th Street Landfill Site Rosedale, Maryland

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Site-Wide Work Plan

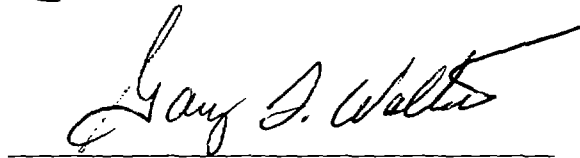
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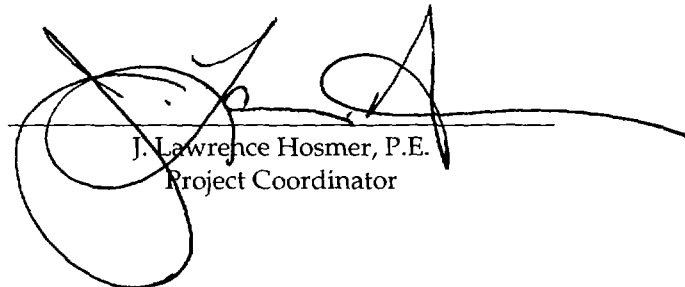
ERM Project No.: 0049608



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RESPONSE TO COMMENTS

SITE-WIDE WORK PLAN 68TH STREET LANDFILL SITE JUNE 18, 2007

Responses to comments issued by the U.S. Environmental Protection Agency (USEPA)-Region III, the USEPA Biological Technical Assistance Group, and the Maryland Department of the Environment (MDE) relative to the Site-Wide Work Plan (SWWP) are presented herein. Each comment is presented verbatim in *italics* with a direct response to the comment immediately below. The responses have been incorporated in the revised SWWP as denoted herein.

USEPA-REGION III

1. *Pg. A-13 Section 2.3 1st para. Check for missing word(s) in the 3rd sentence: "Vertical control..."*

Response:

Page A-13, Section 2.3, Paragraph 1 has been modified accordingly.

2. *Pg. A-19 Task 8 Multi-Media Sampling is discussed on page A-19 of the report. A table listing the number of samples collected from each environmental medium would be helpful.*

Response:

Table 2-2 has added to the Field Sampling Plan (FSP) to summarize historical and proposed Site-wide samples for each environmental medium. Additionally, the text in Section 2.9 of the FSP was modified accordingly.

3. *Pg. A-24 – 25 All blank and duplicate samples should have fictitious IDs to insure their integrity.*

Response:

See response to Comment 4, below.

4. *Pg. A-26 1st para. Last sentence Alternative sample designations should be considered to mask duplicate samples.*

Response:

The sample designations for QA/QC blank and duplicate samples have been considered to mask the sample for submittal to the laboratory. All QA/QC blank and duplicate samples will have alternative designations in place of the sample grid location code. The text has been updated in Section 2.1.2 and 2.9.8 accordingly.

5. *Pg. B-7 2nd para. Correct the typographical error in the last sentence.*

Response:

Page B-7 has been modified accordingly.

6. *Pg. B-19 Section 4.5.3.1 Change "exiting" to "existing."*

Response:

Page B-19, Section 4.5.3.1 has been modified accordingly.

7. *Pg. B-40 Section 12.2 Identify the title and/or name of the person responsible for performing the field audit.*

Response:

The Field Task Manager will perform the field audit. Section 12.2 has been modified accordingly.

8. *Table 7-1 Consider including 1,4-Dioxane as a VOC or as a Semi-Volatile (Table 7-2).*

Response:

1,4 Dioxane has been added to the semi-volatile organic analysis using Method 8270C. Table 7-2 of the QAPP has been modified to indicate that the base reporting limit for water is 2.0 µg/L, the base reporting limit for solids-low level is 6.7 µg/kg, and the base reporting limit for solids-medium level is 67 µg/kg.

9. *Section 1.2 Discuss access routes to the Island Landfill and Colgate Pay Dump. Discuss related issues/concerns.*

Response:

To facilitate repair of the Baltimore County (County) sanitary sewer force main which previously crossed Herring Run elevated at two

locations, the County has permitted and constructed a temporary 12-foot wide stream-crossing between MA-C and the Island Landfill. Although the use of heavy equipment is not anticipated to be required for the investigation of the Island Landfill, this stream crossing is capable of supporting construction-type vehicles. Prior to commencing with the RI field activities, the Coalition will coordinate with Baltimore County and its contractor regarding use of the current stream crossing as this provides the safest and most direct means of access to the Island Landfill. In the event that this option is not made available, the options presented in Table 2 will be evaluated and implemented as appropriate.

Access is also limited in the area of the former Colgate Pay Dump and Original Robb Tyler Landfill (MA-E). Vehicular access to this area is possible via the Moravia Road off-ramp from Interstate 95; however, steep slopes and other conditions (e.g., weather, vegetation, etc.) may restrict this access once in the area. MA-E can also be accessed by personnel fording Moores Run during low flow conditions from the north, or the construction of temporary stream crossings such as that currently employed to access the Island Landfill, or bridging. If necessary, additional access routes may be supplemented by clearing new trails between MA-D and MA-E.

Section 1.2 has been modified accordingly.

10. *Section 1.4 To the extent possible, the HASP should be presented to all visitors prior to their arrival onsite.*

Response:

Section 1.4 has been modified accordingly.

11. *Section 5.0 Change "Section 7.0" to "Section 6.0" in the last sentence.*

Response:

Section 5.0 has been modified accordingly.

12. *Section 5 Site Entry Table 2 MA E Reconsider driving on steep slopes prior to modifying the grade.*

Response:

Prior to driving on steep slopes, the slopes will be walked and visually inspected for stability. No slope greater than 50percent will be

attempted with vehicles. If, after inspecting any slope or after vehicular access is initiated, the slope is determined to be unstable or too steep to sustain vehicular traffic, an alternate route of access will be determined. If no other route of access is determined to be available, modification to the slope grade or other engineering modifications will be utilized to provide a safe route of access to the investigation area.

Table 2 has been modified accordingly.

13. *Section 5 Site Entry Table 2 MA F Include appropriate response actions for personnel falling into the water and/or include an alternative method of crossing Herring Run.*

Response:

Table 2 has been revised to indicate, as noted in the response to Comment 9, that the Coalition will coordinate with Baltimore County to utilize the temporary stream crossing currently available between MA-C and the Island Landfill as the primary access alternate to Source Area 3. Other alternatives are also noted in the table. Further, additional text has been added in the event that personnel fall into the stream.

14. *Section 7.3 Discuss decontamination procedures for Level D.*

Response:

Section 7.3 has been modified to include decontamination procedures for Level D. These procedures will consist of thorough hand washing and proper doffing of PPE. Proper doffing of PPE would, for example, include the removal of inner gloves after decontaminating boots and equipment by turning them inside out. In addition, disposable outer protective garments will be employed to the extent possible to assure that all contaminants remain on the Site.

15. *Pg. C-35 Please reconsider the necessity of inner suits.*

Response:

The use of inner suits, as indicated on Page C-35 has been re-evaluated and determined to be unnecessary; this reference has therefore been removed accordingly.

16. *Section 10.1 Include "Lessons Learned" (from recent experiences) in daily safety meetings.*

Response:

Section 10.1 has been modified accordingly to discuss "lessons learned" at the Site to-date.

17. *Section 11.3.4 Include the name/phone of an appropriate physician or eliminate "Physician".*

Response:

"Physician" has been eliminated from Section 11.3.4.

18. *Section 12.0 Insert the following or similar language at the end of the paragraph "Lessons Learned will be discussed during the daily Safety Meetings."*

Response:

Section 12.0 has been modified accordingly.

19. *Generic Risk Assessment Pg. 18 Preventive Measures Include "Equipment inspected by contractor prior to mobilization."*

Response:

Generic Risk Assessment, Page 18, Preventive Measures has been modified accordingly.

20. *Pg. D-20 Section 3.2.2.1 3rd line Change "al" to "all."*

Response:

Section 3.2.2.1 has been modified accordingly.

21. *Pg. D-22 2nd para. Please identify the referenced EPA guidance.*

Response:

The USEPA guidance that is referenced in this paragraph is USEPA Document Number 600/R-99/064; the full citation is presented in Section 5.0-References. The appropriate reference has been added to Section 3.2.2.2.

22. *Pg. D-31 last bullet, Please provide the reference.*

Response:

The references for the Johnson & Ettinger models include USEPA (2004), "Users Guide for Evaluating Subsurface Vapor Intrusion into Buildings", and USEPA (2007), "Evaluating Vapor Intrusion using the Johnson & Ettinger Model". The references have been added to Section 5.0-References and noted in Section 4.2.1 of the Risk Assessment Work Plan (RAWP).

23. *Pg. D-35 Potentially exposed populations are listed on page D-35 (Section 4.3.2). Future residents are not considered to be potential receptors. The exclusion of this population from risk estimates forces the need for Institutional Controls prohibiting residential development of the site. Even with this provision, potentially potable groundwater needs to be evaluated under a residential risk scenario.*

Response:

Residential land use is not planned for the Site, and it is recognized and acknowledged that Institutional Controls will be required to prohibit future residential development. Due to this restriction, potentially exposed populations would not include a residential scenario (i.e., exposure to soil and groundwater will not be included in the quantitative risk assessment). Nevertheless, groundwater data will be compared to the USEPA - Region III Risk-Based Concentrations for tap water to determine whether constituents of potential concern (COPCs) for groundwater uses exist. This exposure to groundwater will be considered to provide an evaluation of the worst-case scenario. Section 4.3.2 and 4.3.3 have been modified, accordingly.

24. *Pg. D-36 Exposure to commercial workers under a future land-use scenario should consider contact with both surface and subsurface soil. Page D-36 (Section 4.3.3.1) should be corrected to reflect this.*

Response:

Under a future land-use scenario, on-site commercial workers (e.g., office, warehouse and similar workers) will not have the opportunity for exposure to subsurface soil once the Site is re-developed since a soil or pavement cover will be maintained over impacted areas identified in the Remedial Investigation/Feasibility Study (RI/FS) Report. For this reason, direct contact risks to subsurface soils for commercial workers are not reasonably anticipated and will not be estimated; only

risks based on exposure to surficial soil will be addressed. After re-development of the property, only construction, utility and maintenance workers, all classified as "construction workers" will have any access to the subsurface soils. Of these, utility and maintenance workers will only work in "clean corridors" installed to preclude exposure. Construction workers represent another category of risk.

25. *Pg. D-37 In addition to surface water and sediment, recreational receptors can also be exposed to surface soil (incidental ingestion, dermal contact, inhalation of vapors/particulates) and ingestion of fish. Section 4.3.3.2 should be revised accordingly.*

Response:

Section 4.3.3.2 of the RAWP has been revised to include the potential for recreational user exposure to surface soils.

26. *Section 4.4 Include metals and all other categories of contaminants not already included.*

Response:

The intent of Sections 4.4.1 and 4.4.2 were to discuss constituent groups with special toxicological circumstances (i.e., toxicological data obtained from a source other than those sources listed in Section 4.4, page D-39). Nevertheless, additional text has been included to discuss the toxicological assessment for volatile and semi-volatile organics, pesticides, herbicides, polychlorinated biphenyls and metals.

27. *Pg. D-42 1st para. Delete "i.e., 1×10^{-6} to 1×10^{-4} ."*

Response:

Page D-42, Paragraph 1 has been modified accordingly.

inside the main and are also subject to tidal fluctuations. The data should be made to characterize the tidal hydrology (i.e., tidal elevations) as well as extreme flow conditions.

Response:

A more detailed explanation of stream flow measurements, specifically the field and modeling activities that will be used to aid in determining the Site contribution to surface water in a tidally-controlled hydrologic setting, will be included in the MA-F Work Plan. The MAWP for MA-F will include descriptions of a tidal survey and surface-water modeling to compute the influence of tidal fluctuations on the streams within the Site, as suggested. The MA-F Work Plan uses a combination of the proposed shallow piezometers fitted with pressure transducers, as well as stream flow meters and temperature gauges to characterize flow under the high runoff conditions and overall tidal hydrology. This detail was not included in the SWWP but has been incorporated into the evaluation of the Site; a reference to this specific work has been incorporated into Section 2.8.

2. *Appendix A, Task 8: Multi-Media Sampling on Page A-20 presents sampling depths for the surface soil investigation (Section 2.9.1.2). Surface soils are identified as those less than 2 feet. BTAG generally recommends 0-6" as the surface soil depth, however site-specific modifications are made depending on site activities and/or the degree of cover. Careful consideration should be given to ensure that the most biologically active zone and the soil depth most likely to be contaminated are sampled.*

Response:

Soil sampling associated with the site-wide and management area work plans for RI activities will be conducted at the 0 to 6-inch depth below the ground surface. Soil data from 0 to 6 inches will be used in the ecological and the human health risk assessments. If during the field sampling there is an indication of contamination below this depth, deeper samples may also be collected. The text on Page A-20 of the Field Sampling Plan (Appendix A) has been modified accordingly.

3. *Section 2.9.2 presents surface water sampling information. High volume surface water samples (i.e., greater than 1 L as indicated in Table 2-1) will be required to adequately characterize organic compounds such as PCBs/pesticides in surface water.*

Response:

The comment is noted. The required sample volumes for laboratory analysis of organic compounds in waters are provided in Table 4-1 of the Quality Assurance Project Plan (Appendix B).

4. *In Appendix A, a figure should be included that clearly identifies all four waterways (Herring Run, Moores Run, Redhouse Run, and the uppermost reaches of Back River).*

Response:

Appendix A, Figure 2 has been modified to identify Herring Run, Moores Run, Redhouse Run and the uppermost reaches of the Back River more clearly.

5. *In Appendix A, the SOP 6805 Description of Soils will be used during the Geotechnical Evaluation (Section 2.6). This SOP should also be used during the Multi-Media Sampling for Soil (Section 2.9.1).*

Response:

The procedures for describing soils outlined in SOP 6805 will also be used during the sampling of soils for environmental characterization. Multi-Media Sampling for Soil (Appendix A, Section 2.9.1) has been modified accordingly.

6. *Appendix D, Risk Assessment Work Plan, Section 3.0 ecological risk assessment work plan, on Page D-7 states that the results of the screening level ecological risk assessment (SLERA) will be used to guide re-use and remedial decisions. Although SLERA results can be used, the risk characterization is intentionally conservative. Additional Baseline ERA (BERA) work may be required to support re-use and remedial decisions (discussed as a supplemental activity in the SWPP in this section).*

Response:

As noted by BTAG, additional BERA work may be required to support re-use and remedial decisions for wetland and upland soils. If

necessary, additional work will be conducted at the appropriate time to provide the data required to complete the BERA.

7. *Appendix D, Section 3.1.1.4 Potential Ecological Receptors, on Page D-10, should be revised to include plants, soil invertebrates and the American robin as potential receptors for the ERA.*

Response:

The list of potential ecological receptors has been revised to include plants, soil invertebrates and the American robin for the SLERA. The text on Page D-10 of the Risk Assessment Work Plan (Appendix D) has been modified accordingly.

8. *Appendix D, Section 3.1.1.6 Assessment and Measurement Endpoints, on Page D-12, states that assessment endpoints target plant and animal populations and communities, habitats, and sensitive environments. It should be noted that local (i.e., site) populations, communities, and habitats are the focus of the ERA.*

Response:

Appendix D, Section 3.1.1.6 Assessment and Measurement Endpoints, Page D-12 has been modified accordingly.

9. *Appendix D, Section 3.1.2 Screening Level Exposure Estimate and Risk Calculation, on Page D-12 discusses the use of area use factors (AUFs). The AUF for the SLERA should be 1. Derivation of AUFs for a particular receptor should be discussed with the BTAG before modifications are made. In addition to published foraging areas, the quality and quantity of habitat at and in the vicinity of the site are considered among other factors.*

Response:

The AUFs for all ecological receptors will be set to 1 for the SLERA. The text on page D-12 of the Risk Assessment Work Plan (Appendix D) has been modified accordingly.

10. *Appendix D, Section 3.2 BERA for Aquatic Environments, should address anadromous fish such as blueback herring or shad which use the aquatic habitats for spawning and juvenile habitat. This should be addressed in qualitative evaluations of fauna (D-23) and when evaluating potential impacts on critical life stages (i.e., eggs and larvae) for these species in addition to fish body burden measurements.*

Response:

Although it is not certain whether migrations of anadromous fish occur in the aquatic environments at the Site, observations for anadromous fish will be included in the qualitative survey of aquatic biota. In addition, potential impacts to critical life stages of anadromous fish will be addressed by comparing fish body burden measurements to literature-derived effects values on critical life stages, such as reproduction and development of eggs and larvae. Since the survey may be conducted in the Fall of 2007, the survey may not include any actual measurement of body burdens for species that migrate in the Spring. Nevertheless, measurements of fish body burdens for resident species will be made. These are likely to be greater with respect to Site-specific exposures than those that would occur for Spring migrants. Therefore, reliance upon fish body burdens collected from resident species should be adequate to evaluate transitory species; this is particularly true given that the migratory species will have lower exposures via the food web. *Section 3.2-Baseline Ecological Risk Assessment (BERA) for Aquatic Environments* has been modified accordingly.

Appendix A Field Sampling Plan

1. *Section 2.5.1 Soil Borings, page A-15*

The discussion of auger refusal should include a notation that the refusal will be noted in the RI.

Response:

Auger refusal, if any, will be recorded in the field and subsequent RI. Section 2.5.1 has been modified accordingly.

Appendix B Quality Assurance Project Plan

1. *Section 8.0 Data Reporting, Validation and Reduction, Page B-27, second paragraph*

This paragraph (along with Section 12.4) indicates that data validation will be conducted by the Quality Assurance Chemist at each laboratory responsible for conducting the analysis. While data validation by the laboratory is valuable, an independent validation phase is typically conducted to ensure impartiality of the validation process.

Response:

The Laboratory Quality Assurance Chemist will qualitatively and quantitatively review the data packages prior to shipment to the Site QA Manager. Thereafter, an independent validation of the data will be performed, as specified in Section 12. Section 8.0 has been modified accordingly.

Appendix E Standard Operating Procedures

1. *SOP-6804, Standard Operating Procedure, Soil Boring, Monitoring Well and Piezometer Abandonment, Section 3.3, Procedures for Decommissioning of Wells or Piezometers Installed in Soil/Overburden Materials*

This section should be revised to incorporate Maryland well abandonment requirements found in COMAR 26.04.04.11. Specifically, some of the COMAR requirements that should be included are:

- *COMAR 26.04.04.11 F (1) (d) In drilled wells, if it is not possible to remove the casing, the casing may be ripped or perforated to assure that sealing material fills all annular spaces and voids.*
- *COMAR 26.04.04.11 F (2) (b) (i) A well in unconsolidated material in an unconfined ground water zone (Hydrogeologic Area 1) shall be filled and sealed by placing fill material in the well to the level of the water table, and filling the remainder of the well with sealing material. If the water table is at a depth greater than 40 feet, a minimum of 40 feet of sealing material shall be required.*
- *COMAR 26.04.04.11 E (1) (e) Bentonite clay, when applied as a heavy mud-laden fluid under pressure, has most of the advantages of cement grout but under some conditions may be carried away into the surrounding formation. A bentonite clay mixture shall be composed of not less than 2 pounds of clay per gallon of water. Bentonite clay may not be used where it will come in contact with waters of a pH below 5.0 or total dissolved solids content greater than 1,000 mg/l or both.*

Response:

Section 3.3 of SOP-6804, Standard Operating Procedure, Soil Boring, Monitoring Well and Piezometer Abandonment has been modified accordingly.

2. *SOP-6804, Standard Operating Procedure, Soil Boring, Monitoring Well and Piezometer Abandonment, Section 3.5, Procedures for Decommissioning of Wells or Piezometers Installed in Bedrock.*

See comment 1 above.

Response:

Section 3.5 of SOP-6804, Standard Operating Procedure, Soil Boring, Monitoring Well and Piezometer Abandonment has been revised accordingly.

3. *SOP-6806, Standard Operating Procedure, Monitoring Well and Piezometer Installation*

This section should discuss the applicability of the requirement for well permits specified in COMAR 26.04.04.07.

Response:

Section 4.0 (Documentation) of SOP-6804 Standard Operating Procedure, Monitoring Well and Piezometer Installation has been

modified to incorporate the well installation permit requirements specified under the Code of Maryland Regulations (COMAR) 26.04.04.03-07.

4. *SOP-6806, Standard Operating Procedure, Monitoring Well and Piezometer Installation, Section 3.0 Procedures*

This section should be revised to incorporate Maryland well construction requirements found in COMAR 26.04.04.07. In particular, the restriction on the use of bentonite clay should be addressed:

26.04.04.07 G (4) (b) Bentonite Clay. A sodium-base bentonite clay may be used to fill the annular space in Hydrogeologic Areas 1 and 2 in a ratio of not less than 2 pounds of bentonite clay per gallon of water. Bentonite clay may not be used for grouting where it will come in contact with ground waters of a pH below 5.0 or a total dissolved solids content greater than 1,000 mg/l.

Response:

Section 3.0 of the SOP has been revised to indicate that all well construction information will be recorded and will conform to the construction standards outlined in COMAR 26.04.04.07. Additionally, when bentonite pellets or chips are installed in non-saturated conditions, approximately two to five gallons of potable water will be added to the pellets or chips for hydration in a ratio of not less than 2 pounds of bentonite per gallon of water. Bentonite will not be used as an alternative form of grouting the entire annulus if the water is below pH 5.0 or with total dissolved solids (TDS) content over 1,000 mg/L to conform to COMAR 26.04.04.07 G (4) (b).

5. *SOP-6808, Standard Operating Procedure, Monitoring Well and Piezometer Installation*

It is important to distinguish between investigation derived waste (IDW) and investigation derived media (IDM) in this work plan. Maryland regulations impose stringent management practices for wastes, including treatment and disposal practices.

Investigation derived media (IDM) describes the groundwater, surface water, soils and sediments that are collected during field activities. Specifically, IDM may include development and purge water from monitoring wells, drill cuttings, and extra soils removed during sample collections. To evaluate whether the IDM must be managed as hazardous waste, the preliminary inquiry is whether the IDM is a solid waste, as defined in Maryland's Environment Article, § 7-201(t) and COMAR 26.13.02.02. Uncontaminated

IDM need not be considered a solid waste, as long as that IDM: 1) will not be abandoned in an environmentally unsound manner; and 2) is not inherently waste-like.

Because the IDM originates from a site being investigated under CERCLA authority, there must be some initial evaluation as to whether the IDM is contaminated or inherently waste-like. As guidance, IDM must be handled as a solid waste when:

- 1) It is visually or grossly contaminated;*
- 2) It has activated any field-monitoring device indicating the presence of volatile organic compounds (VOC) or metals;*
- 3) On previous monitoring/sampling activity, it has exhibited levels of contamination above accepted environmental quality standards;*
- 4) Based on historical information, the responsible party or the regulatory agency believes it warrants caution or additional testing.*

IDM with contamination should be viewed as inherently waste-like unless or until the media is no longer contaminated, or is treated or recycled. As with any solid waste, the generator must perform a hazardous waste determination. If the waste is a hazardous waste, then it must be disposed of through an appropriate hazardous waste disposal facility. If the waste is not a hazardous waste, then that IDM may be disposed of through any permitted or authorized waste management facility willing to accept the waste, or recycled or reused in a manner permissible under the law.

Naturally occurring media that does not exhibit any of the characteristics or concerns described above need not be managed as a waste, particularly if the material will be returned to a suitable location on the facility. Unless otherwise specified, the handling or disposition of this material must be performed in such a manner, so that potential impacts to the environment are avoided. The facility must comply with all pertinent sediment and erosion control regulations. In addition, seeding and the judicious discharge of non-contaminated water to ensure infiltration will be considered the minimum steps necessary to ensure non-degradation of the environment.

Response:

The text in each section of the Site-Wide Work Plan has been modified to reflect the use of the term "Investigation Derived Media (IDM)" in lieu of the term "Investigation-Derived Waste (IDW)" throughout the RI/FS field activities. SOP 6808 - Investigation Derived Waste (now

Media) has been revised to include a flow chart (Attachment 1) to aid in determining the appropriate IDM disposal actions and reflects the suggested changes derived from the MDE comment. A summary of the revisions is included below.

All solid materials that cannot be returned to the test-pit, borehole, or other original sampling location will be evaluated through a combination of visual observation (i.e., assessing unnatural staining or discoloration, presence of non-aqueous phase liquids (NAPL), unnaturally occurring media, etc.) and field screening with an organic vapor analyzer (OVA) and/or other field monitoring equipment to determine if the IDM is potentially contaminated or inherently waste-like. In the event that the IDM does not appear to be inherently waste-like and does not activate the field monitoring device above background or ambient levels, solid media will be spread on the ground surface in the immediate vicinity of its origin and seeded.

For small quantities of water (20 gallons or less per well or waters generated during decontamination of field equipment), the water will be bailed or pumped onto the ground surface. Visible NAPL or sheen will first be removed with an appropriate absorbent material or decanted into an appropriate container (e.g., 5-gallon pail or drum with a lid). The remaining water will then be passed through a filter bed of activated carbon before discharging to the ground surface.

Solid material that is inherently waste-like or activates the field monitoring equipment above background or ambient readings, as well as NAPL and liquids with sheens, will be containerized and subsequently sampled for analysis to determine if the IDM is a waste. Large quantities of water (greater than 20 gallons per well or waters generated during decontamination of field vehicles) will be containerized and subsequently sampled for analysis to determine if the IDM is a waste.

Solid materials determined to be non-hazardous wastes will be either disposed off-site at an approved disposal or treatment facility or stored in a secure on-site location (i.e., a locked sea-going container or fenced area) for consideration in the final remedy. Waters that are determined to be non-hazardous wastes will be disposed off-site in an approved disposal or treatment facility. Any IDM that is determined to be a hazardous waste (including NAPLs and liquids with sheens) will be transported off-site and disposed at an approved waste disposal or treatment facility. The transportation and disposal of all non-hazardous and hazardous materials will conform to all applicable federal, state and local regulations.

1.0

INTRODUCTION

On behalf of the 68th Street Sites Coalition (Coalition), Environmental Resources Management, Inc. (ERM) has prepared this Site-Wide Work Plan (SWWP) for the conduct of the Remedial Investigation/Feasibility Study (RI/FS) specified for the 68th Street Landfill Site (Site) located in Rosedale, Maryland. This SWWP conforms to the Administrative Settlement Agreement and Order on Consent (ASAOC), CERCLA Docket No. CERC-03-2006-0051 RF, dated April 27, 2006, and the Statement of Work (SOW) attached thereto. Specifically, this deliverable complies with the requirements stipulated in Section IX and Appendix C – Statement of Work (SOW), Section 5. of the ASAOC.

1.1

PURPOSE

The goal of the SWWP is to establish protocols that will govern all RI/FS-related activities that are common across the Site and without bias to a specific location, medium or potential re-use opportunity. Specifically, the SWWP is comprised of separate plans to address sampling and analytical procedures, quality control procedures, health and safety, and procedures to be considered in conducting the human health and ecological risk assessments. In accordance with the ASAOC, this document includes the following four (4) plans:

- Field Sampling Plan (FSP);
- Quality Assurance Project Plan (QAPP);
- Health and Safety Plan (HASP); and,
- Risk Assessment Work Plan (RAWP).

Overall, sample collection and analysis is focused on the data necessary to fill the gaps identified in the Site-Wide Program Management Plan (SWPMP), Section 3.0, and in the Final Data Gap Analysis (DGA), as described in the ASAOC Statement of Work (SOW). Additionally, Standard Operating Procedures (SOPs) were prepared as Site-specific protocols to guide the activities addressed by this SWWP; these SOPs are appended hereto for reference during implementation of the investigation activities. The component plans and procedures will hereinafter be collectively referred to as the “Project Control Plans” because they provide the methods for controlling various discipline-specific aspects of the RI/FS activities applicable across the entire Site. Procedures required for a specific location or Management Area (MA) will be subsequently addressed in the Management Area-Specific Work Plans, and will consist of refinements of these more general guidelines. General project or Site information, such as

background, history, and description, is presented in prior submittals, including the Project Management Plan, dated August 28, 2006, and the Site-Wide Program Management Plan, dated November 13, 2006, and is therefore not repeated herein.

1.2

PLAN ORGANIZATION

The Project Control Plans have been prepared in accordance with established USEPA guidance, and present procedures specific to each of the technical areas listed below as they relate to the entire Site. The plans are presented in separate appendices to permit extraction and use as stand-alone references for specific actions during RI/FS activities. Consequently, the contents of the SWWP include the Project Control Plans, as organized below:

- **Appendix A: Field Sampling Plan.** The FSP establishes baseline procedures to ensure the integrity and consistency of Site characterization activities, including sampling and documentation, and the validity of samples collected during the RI;
- **Appendix B: Quality Assurance Project Plan.** The QAPP establishes baseline procedures to ensure the integrity of sample quality, field measurements and the validity of analytical data generated during the RI;
- **Appendix C: Health and Safety Plan.** The HASP identifies health and safety hazards posed by the Site for consideration during the implementation of the RI, and establishes procedures and requirements to ensure worker protection;
- **Appendix D: Risk Assessment Work Plan.** The RAWP establishes the overall approach and procedures to be implemented during the evaluation and assessment of human health and ecological risks at the Site; and,
- **Appendix E: Standard Operating Procedures.** The SOPs provide a description, protocol, and materials necessary to conduct a specific activity associated with the field investigation tasks in a precise, controlled and duplicative manner.

As noted above, these appendices address common RI/FS activities required across the Site without bias to a specific area. Any additional details or procedures required for specific locations will be addressed in the MA-Specific Work Plans to be prepared and submitted subsequent to this SWWP. However, if Site-wide work beyond the scope of these documents is required, amendments or modifications to these Project Control Plans will be prepared to address those situations.

APPENDIX A

Field Sampling Plan

68th Street Landfill Site Rosedale, Maryland

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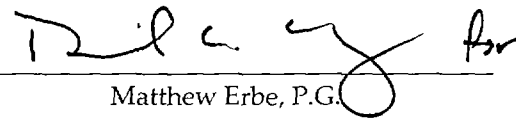
June 18, 2007

Field Sampling Plan

68th Street Landfill Site
Rosedale, Maryland

June 18, 2007

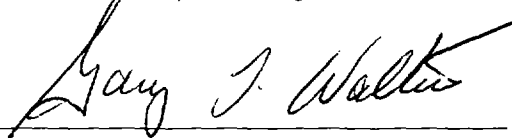
ERM Project No.: 0049608



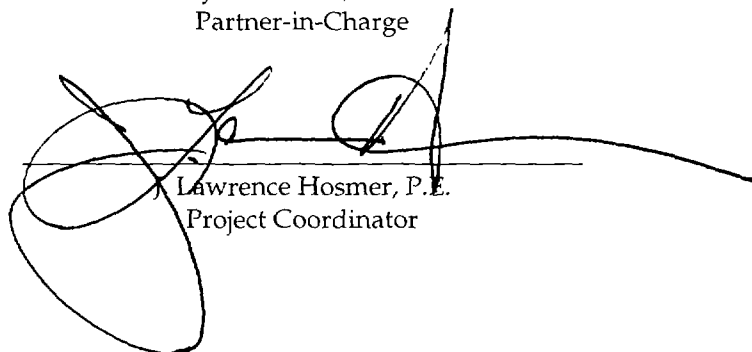
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1.0 INTRODUCTION

1.1 PURPOSE

The 68th Street Sites Coalition (Coalition) is conducting a Remedial Investigation/ Feasibility Study (RI/FS) of the 68th Street Landfill Site (Site) located in Rosedale, Baltimore County, Maryland. This Field Sampling Plan (FSP) is a project control document prepared to support implementation of the Statement of Work (SOW) included as Appendix C to the Administrative Settlement Agreement and Order on Consent (ASAOC), as specified in the Site Wide Program Management Plan (SWPMP) dated February 23, 2007. The FSP is one component of the Site-Wide Work Plan (SWWP) and describes the standard methods and procedures for field activities to be performed during implementation of the scope of work presented in the SWPMP.

The FSP presents specific information on the following:

- aerial topographic surveying;
- analysis of historical aerial photography;
- methods and procedures for surface geophysical surveys, soil borings, test trenches and pits, geotechnical sampling and field analysis, soil-gas sampling, monitoring well and piezometer installation, water-level monitoring, and the collection of groundwater, leachate seep, surface-water and sediment samples;
- methods and procedures for the collection, documentation, custody, handling and shipment of environmental and geotechnical samples;
- chemical and physical analyses to be performed on samples;
- equipment decontamination procedures; and,
- management of investigation-derived wastes.

The FSP will serve as a comprehensive guide for use by field personnel during execution of RI-related field activities. In this role, the FSP will provide sufficient information for field teams to properly conduct data collection and sampling activities that will generate data consistent with the Quality Assurance Project Plan (QAPP) requirements. However, it should be noted that the Management Area (MA)-Specific Work Plans will provide additional specifics on the sample locations, depths and analyses for each investigation technique and environmental medium.

The primary sampling objective during the RI is to collect data of sufficient quality and quantity to define the nature and extent of Site impacts to the degree necessary to complete human health and ecological risk assessments, as well as a feasibility study of potential alternatives for final Site remediation. The purpose of this FSP is to describe the methods and procedures to be implemented during RI field activities to accomplish the sampling objective. Data collection presented in the FSP will also focus on collecting those data necessary to fill the data gaps identified in the SWPMP (Section 3.0). The sampling objective will be accomplished by implementing the scope of work presented in the SWWP using the methods and procedures described in this FSP while conforming to the QAPP, HASP and RAWP; these documents are outlined in the following:

- Remedial Investigation/Feasibility Study Quality Assurance Project Plan for the 68th Street Landfill, Rosedale, Baltimore County, Maryland, (QAPP) (2006) – Appendix B; and
- Remedial Investigation/Feasibility Study Health and Safety Plan for the 68th Street Landfill, Rosedale, Baltimore County, Maryland, (HASP) (2006) – Appendix C;
- Remedial Investigation/Feasibility Study Risk Assessment Work Plan for the 68th Street Landfill, Rosedale, Baltimore County, Maryland, (RAWP) (2006) – Appendix D.

Lastly, this FSP is intended to be a “living” document; as activities change or results are obtained from the investigations, modifications may be required which will dictate that this FSP be revised or amended. The most current FSP will be maintained at the Site during all field activities; each document is dated in the lower right hand corner of each page to assure that the most current version is implemented.

1.2

ORGANIZATION

The remainder of this FSP is organized as follows:

- *Section 2.0 – Field Methods.* This section provides a description of the tasks to be completed during the implementation of the FSP;
- *Section 3.0 – Sample Handling.* This section describes the methods and materials necessary to safely handle, preserve and transport samples collected during the implementation of the FSP;
- *Section 4.0 – Analytical Procedures.* This section provides a brief description of the analytical laboratory procedures; these are more thoroughly described in the QAPP;
- *Section 5.0 – Decontamination Procedures.* This section identifies the proper decontamination of drilling and sampling equipment in order to

minimize the possibility of cross contamination of environmental samples;

- *Section 6.0 – Investigation Derived Media.* This section identifies the procedures for disposing of waste materials generated during the field investigations;
- *Section 7.0 –Field Equipment.* This section identifies the appropriate procedures for proper upkeep of field equipment to minimize the possibility of malfunctions and increase the reliability of the data collected in the field; and,

1.3

CONTACT PERSONNEL

Contacts with respect to implementation of the FSP should be made to the following individuals, by category and in ascending contact order:

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1.4

SCOPE OF WORK

As discussed in Section 3.0 of the SWPMP, the USEPA defined the Site by Source Areas 1 through 5. To effectively manage the RI/FS activities while considering the potential for re-use, the study area for the RI has been divided into Management Areas. The physical relationship and boundaries of the Management Areas and Source Areas, as defined in the SWPMP, are presented in Figure 2.

This FSP outlines the eight tasks to be performed during the RI that are associated with the investigation of Management Areas A through F. The major field activities associated with these tasks, and addressed in this FSP are summarized below:

- Task 1: Review of Historical Aerial Photography. Prior to initiating sampling activities, historic aerial photographs will be examined for terrain analysis purposes and used to modify, as necessary, media sampling locations for any areas of concern that are not currently targeted by the boring and sampling locations.

- Task 2: Site Topographic Survey. A topographic survey of the Site will be conducted to generate a base map of the Site and establish horizontal and vertical control to determine the location and elevation of sampling points and other Site features. This task will also establish a grid system that will aid any sampling activities conducted under the remaining Tasks 3 through 8.

- Task 3: Disposal Area Evaluation. Historic aerial photography, topographic maps, borings, electromagnetic (EM) geophysical survey, test pits and trenches, and auger methods will be used to delineate water zones, the depth of the waste, and to define the boundaries of historical on-Site waste disposal.

- Task 4: Monitoring Well and Piezometer Installation. Shallow monitoring wells and small-diameter piezometers will be installed to determine the direction of local, near-surface groundwater flow, and will also be used to collect groundwater samples for chemical analyses to characterize the nature and extent of the constituents of concern (COCs) in groundwater. In addition, the data collected will be used to evaluate any potential discharges to surface waters from migrating shallow groundwater (see Task 8c).

- Task 5: Geotechnical Evaluation. Geotechnical samples for analysis of soil parameters will be collected to evaluate the physical characteristics of soils and other subsurface materials present at the Site. Some of these samples will also be collected during drilling activities to install monitoring wells and piezometers (Task 4). Samples will be collected and analyzed to assure that redevelopment areas are adequately characterized from a stratigraphic, strength and consolidation potential standpoint. Geotechnical investigations will focus on those areas of the property where soil composition is most uncertain; i.e., the "Made Land" soil type, and where active re-use (including potential building construction) is most likely to occur.

- Task 6: Cover System Thickness Evaluation. Shallow soil borings will be installed throughout the Management Areas and proposed redevelopment areas to evaluate the presence and thickness of previously-installed cover soil. The investigations will consist of hand

auger and direct-push Geoprobe™ probe methodologies installed in a grid pattern. The results of the thickness assessments will assist in containment remedy evaluation.

- Task 7: Stream Gauging. To evaluate tidal fluctuations that impact the primary drainageways that transect the property, and a number of hydraulically-upgradient and downgradient industries, an accurate assessment of the relative hydraulic impact of any Site releases on regional surface-water quantity and quality is important. The investigation will require the measurement of flow into and out of the Site during various flow conditions (e.g., low flow, storm events, low tide, high tide), and along each drainageway.
- Task 8: Multi-Media Sampling and Analysis. This task is sub-divided into seven sub-tasks by investigation component, described individually, below.
 - Task 8a: Soils Investigation. Surface (i.e., < 2-foot depth) and subsurface (i.e., > 2-foot depth) soil samples will be collected from soil borings for chemical analyses to characterize the nature and extent of COCs present in soils. Background samples will also be collected from nearby urban parks (i.e., Herring Run Park, Moores Run Greenway, and Batavia Park within Herring Run, Moores Run, and Redhouse Run watersheds, respectively) and wetlands to establish the regional natural and anthropogenic levels of chemical constituents in soil. Exposed soils along stream banks will also be sampled, particularly where scour is present. Further explanation of the background sampling is provided in the Management Area-Specific Work Plans.
 - Task 8b: Surface-Water Sampling and Analysis. Surface-water samples will be collected from locations in Herring Run, Moores Run, Redhouse Run and in the uppermost reaches of Back River for chemical analyses to characterize surface-water quality in the vicinity of the Site and enable an assessment of contaminant mass loadings from the Site to Back River.
 - Task 8c: Groundwater Sampling and Analysis. Near-surface groundwater samples will be collected from the monitoring wells and piezometers and analyzed to characterize the nature and extent of COCs in shallow groundwater, particularly as it relates to discharges to the Site surface waters.

- Task 8d: Leachate Seep Sampling and Analysis. If any leachate seeps are identified during the RI field activities, leachate seep samples will be collected from those locations for chemical analyses to characterize the composition of discharges to the Site surface-water and to facilitate an assessment of potential adverse impacts to surface-water quality from COCs associated with the Site.
- Task 8e: Sediment Sampling and Analysis. Sediment samples will be collected from designated locations in Herring Run, Moores Run, Redhouse Run, and Back River for chemical analyses to characterize sediment quality and to facilitate an assessment of potential adverse impacts to downstream sediments from COCs associated with the Site.
- Task 8f: Soil-Gas Sampling and Analysis. Soil-gas sampling will be conducted to assess any potential human health exposure risks (i.e., via inhalation), or gas accumulation potential in the subsurface with respect to planned Site re-use opportunities. Soil-gas samples will be obtained through monitoring points installed into the subsurface, and below any existing cover soil, using direct-push Geoprobe™ techniques. The monitoring points will include tubing that extends to the surface and will be connected to field monitoring devices or SUMMA® canisters for volatile organic compound (VOC) analysis (i.e., TO-15), as necessary.
- Task 8g: Biological Sampling and Analysis and Habitat Survey. Biological samples (i.e., fish tissue samples) will be collected from locations in Herring Run and the upper reaches of Back River (and potentially from locations in Moores Run and Redhouse Run) for chemical analyses to be applied to the ecological risk assessment. This data will be used to evaluate any adverse impacts to aquatic life from COCs potentially associated with the Site. A reconnaissance (habitat) survey will also be conducted.

The above tasks will address many of the data gaps presented in the SWPMP. Additional activities, such as background evaluation, Site-wide reconnaissance and mapping, and other detailed analyses will be further addressed in the Management Area-Specific Work Plans.

2.0 *FIELD METHODOLOGY*

2.1 *GENERAL*

2.1.1 *Sample Types*

Two general types of environmental media samples will be collected: discrete (i.e., grab) samples and composite samples. Discrete samples are collected at a single point in time, from a single location or over a discrete depth interval, and must be collected under the same conditions for all constituents. For example, all of the water volume required for a discrete monitoring well sample must be collected from the same depth in a well. Likewise, discrete soil samples must be collected from the same depth and location at each sampling point. Discrete surface-water samples are collected from one point, and at one depth.

Composite samples are obtained by combining samples from several different locations (e.g., various depths for soil samples). Samples can be composited based on sample volume, sample depth, sample weight, flow rate or time. Compositing involves combining the individual sub-samples, and generally involves extra exposure to the air during which volatile organic constituents are lost in the compositing process. Samples to be analyzed for volatile organics (i.e., both soil and water samples) are therefore not composited.

2.1.2 *Sample Containers and Labeling*

Each multi-media environmental sample will be assigned a unique sample identification number during the RI field activity. This sample identification number will follow a format using the following series of data: Site code – Management Area code – Sample Grid Location code – Media code (“SW” for surface water, “SS” for soils, “GW” for groundwater, “DS” for subsurface soils, “BL” for biological, “SE” for sediment, “LS” for leachate seep, and “SG” for soil-gas) – Sample code (“G” for grab, “C” for composite) – Depth in feet – QC code (when applicable) – and the Date (mm/dd/yyyy). For instance, the initial grab soil sample from grid R12 would be designated 68-E-R12-SS-G-0-0.25-date. A duplicate of this sample would be 68-E-R12-SS-G-0-0.25-D-date.

To mask the identity of samples submitted to the laboratory for quality control evaluation, QA/QC samples will receive alternate designations in place of the Grid Location code as follows Z1 – trip blank, Z2 – equipment blank, Z3 – field blank, and Z4- field duplicate. For example a field duplicate of the above sample would be designated on the chain of custody as “68-E-Z4-SS-G-depth-date”. Trip blanks, equipment blanks and field blanks will use the Media code “SW”. The

“MS/MSD” designation will follow the date for matrix spike/matrix spike duplicate samples. The actual identification of the samples will be recorded in the field log book.

Samples will be placed in the appropriate containers based on medium and analysis. A cross reference list of media, analysis, appropriate preservation requirements, and sample container is provided in Table 2-1.

2.1.3 *Field Notebook*

Dedicated project field notebooks (i.e., fieldbook, field notebook or logbook) will be maintained to document sampling activities during the field activities; each field notebook will be bound with numbered pages, and maintained by each field sampling team member. Sample collection forms and/or figures and drawings may also be used to record field information. Guidance for recording information in a fieldbook is presented in SOP 6828 (Appendix E).

2.1.4 *Photographic Documentation*

Wherever possible, field sampling locations will be recorded using a digital camera. The photograph number will be recorded in the field notebook along with a brief description of the photograph.

2.1.5 *Field Audit*

An on-Site field audit will be conducted during the initial sampling activities to review sampling procedures and the field-related quality assurance activities of the sampling team. The field audit will be conducted by an individual designated by the Quality Assurance (QA) Manager, and who is experienced in conducting field sampling programs but is not a member of the field sampling team for that particular field activity.

During the field audit, the sampling collection and sample handling practices of the field team will be observed, scrutinized and reviewed to ensure that they are in compliance with the requirements of the FSP and QAPP. If deficiencies are identified during the field audit, corrective action measures will be implemented immediately to ensure compliance with FSP and QAPP requirements.

2.2 *TASK 1: AERIAL PHOTOGRAPHIC ANALYSIS*

Historical aerial photography has been compiled and will be examined to identify and/or confirm historical waste disposal areas, corresponding soil boring/monitoring well locations, and surface geophysical survey transects. These activities will utilize previous aerial photography interpretation as the

basis, expanding and refining that information as necessary (Aero-Data Corporation, *Statement of Opinions, Wayne M. Grip, Concerning Interpretation of Aerial Photographs Showing Source 5 Area, 68th Street Dump, Proposed National Priority List Site*, Rosedale Baltimore County, Maryland, July 2003). The resulting locations of former disposal areas will be transferred from the historic aerial photographs to a scaled map of the Site for reference purposes. This approach will permit more accurate placement of the soil borings and monitoring wells at the locations presented in the MA-Specific Work Plans.

2.3

TASK 2: TOPOGRAPHIC SURVEY

A topographic survey will be performed by a Maryland-licensed land surveyor, based on recent aerial photography, to create a scaled base map of the Site to national map accuracy standards, and to establish horizontal and vertical control for determining the locations and elevations of sampling points and other significant Site features. Horizontal control will be established relative to the Maryland State Plane Coordinate System. Vertical control will be established relative to the 1988 North American Vertical Datum (NAVD 1988). All horizontal coordinates will be determined to the nearest one foot, and vertical elevations will be determined to the nearest 0.01 feet. It is anticipated that the survey will provide data to generate a Site base map with a topographic contour interval of one foot given the relatively flat terrain over a portion of the Site and the future utilization of this information for re-use design purposes. A first-order land survey will meet both current RI requirements and future engineering needs during Site remediation and/or re-use activities.

Each programmed soil boring and monitoring well location will be identified in the field, and marked, by the sampling team using a hand-held Global Positioning System (GPS) unit with an estimated resolution of +/- 5 meters (approximately 16.4 feet). The field team will also record the Site-specific grid coordinates (Section 2.3.1). For completed monitoring wells, the final horizontal location and top-of-casing elevation will be determined by land survey techniques to permit the future long-term, accurate measurement of groundwater elevations.

Survey data will be used to generate a Computer Aided Design (CAD) and a Global Imaging System (GIS) file of the base map for use with commercial CAD and ArcGIS™ computer software during data evaluation and design activities. The CAD and GIS files generated from the topographic survey will also permit the creation of Site maps at various scales for graphical plots of the data during RI field activities as well as for the presentation of data in the RI reports.

2.3.1

Site-Wide Grid System

A grid system will be established for the Site to aid in navigation and the identification of field sampling locations during implementation as well as afterward. The grid for the Site will be established at 200-foot centers, with a unique alpha-numeric combination assigned to each grid square on a cardinal direction orientation. The proposed grid system is depicted on Figure 3.

2.4

TASK 3: DISPOSAL AREA EVALUATION

Intrusive and non-intrusive activities will be conducted to provide information on subsurface conditions. The specific objectives of the disposal area evaluation are to more precisely delineate the lateral limits of the Source Areas, to project the vertical thickness and bottom of the waste, to identify zones of perched and permanent groundwater, and to assess subsurface physical conditions within the disposal areas.

The aerial photographic analysis and topographic survey described above (Tasks 1 and 2) will be used to confirm and/or refine the approximate lateral limits of waste within each Source Area. A surface geophysical survey using electromagnetic (EM) conductivity will be conducted along various transects perpendicular to the USEPA-estimated limits of disposal (delineated as the Source Areas) associated with each Source Area. Each transect will be relatively short in length and will cross the disposal boundary at a standard interval. Test pits and trenches will be excavated at some of the transect locations to calibrate the EM survey results. Hand- or mechanical-augering may be used in areas that are not accessible to the geophysical and test pit/trench equipment.

The electromagnetic (EM) survey will use an EM-31™ conductivity meter, or equivalent, which will screen each transect to define the lateral limits of the waste. The EM-31 is coupled with a GPS unit to permit acquiring geographic coordinates for every EM-31 measurement obtained.

Site conditions, including subsurface fill and rubble, may affect the quality of the geophysical survey results by creating excessive background “noise” that limits the usefulness of the geophysical data. To address this potential concern, the geophysical survey will be correlated with test pits and trenches. In the event that the initial geophysical data does not provide meaningful data when compared to the test pit/trench observations, other methods will be considered to achieve the objectives stated above.

Rather than conducting a geophysical survey across the breadth of each Source Area, additional borings to those presented in the SWPMP will be installed in a grid pattern to assess the vertical extent of the waste, the perched and permanent groundwater table, and any layering of the waste. The location of all such

supplemental borings will be determined and presented in the Management Area-Specific Work Plans.

Some Site clearing will be required to facilitate the geophysical survey and test pits/trenches. The extent of clearing will be determined through consultation with the geophysical survey contractor.

2.5 **TASK 4: DRILLING ACTIVITIES**

Drilling activities will be conducted in support of the geotechnical explorations and testing, the existing waste cover survey, monitoring well and piezometer installation, and soil sampling activities. Wherever possible, sampling locations will be collocated to minimize surface and contaminant disturbance and the duplication of field efforts. The following sections describe these intrusive activities.

2.5.1 **Soil Borings**

Soil borings will be completed using three general methods: (1) standard hollow stem auger drilling equipment and split-spoon sampling methods; (2) hand-auger drilling and sampling; or, (3) direct-push drilling and sampling methods, as procedurally described in the Standard Operating Procedures (SOP) 6800, 6801, and 6802 (Appendix E), respectively. The boring technique for each sampling/drilling location will be based on Site conditions, including access, subsurface composition, and sample analytical requirements. As an additional safety protocol, air monitoring for explosive/combustible vapors (i.e., methane and volatiles) will be conducted during any drilling activities where waste-generated gases could be present. The Health and Safety Plan (Appendix C of the SWWP) further discusses these monitoring activities. The completion depth of each boring will be based on field observations and sample analysis (i.e., the purpose of the boring). In the event that auger or probe refusal is encountered prior to completing a boring to the target depth, the boring location will be offset approximately 5 to 10 feet from the original location, and a second attempt will be made to reach the target depth. If auger refusal is encountered at the initial off-set location, no further attempts will be made to complete the boring; refusal may be due to the presence of buried solid debris at a given location. Refusal, if achieved, will be recorded in the fieldbook and noted in the Remedial Investigation Report.

Soil samples will be collected continuously from the ground surface to the final depth of each boring using either split-spoon, direct push drilling, or hand-auger methods. Descriptions of the soil samples will be logged in the field, and observations recorded in a bound fieldbook. After completion of the soil boring program, a Drilling Log will be prepared following SOP 6805 (Appendix E) for

each boring to document the physical characteristics of each soil sample and field observations made during drilling and sampling. Soil samples will be screened in the field with an organic vapor analyzer (e.g., photo-ionization detector, or PID) using the procedure described in SOP 6803 (Appendix E).

At the time of sample collection, soil samples will be properly labeled and immediately placed in a cooler with ice or ice packs to maintain the proper temperature for delivery to the laboratory. Samples will be labeled and handled in accordance with the requirements described in Section 3.0; requirements for sample documentation and handling are also presented in Section 3.

Upon completion of each soil boring, the boring will be backfilled with soil cuttings as described in SOP 6804 (Appendix E).

2.5.2 *Shallow Groundwater Wells*

Several soil borings at select locations will be converted to shallow groundwater wells upon completion. The groundwater investigation consists of activities to assess Site-wide groundwater quality and determine the local, near-surface direction of groundwater flow beneath the Site. These activities include the installation of groundwater monitoring wells in upland areas with drilling rig access, and piezometers in soft-soil locations near streams or wetlands; water - level monitoring; and the collection of groundwater samples for chemical analysis.

The shallow monitoring wells will be installed in accordance with the requirements of COMAR 26.04.04.07 and SOP 6806 (Appendix E). Wells will be installed to a depth of approximately 5 feet below the near-surface groundwater table using either hollow stem auger, rotary, hand-auger, or direct-push drilling methods. After groundwater is initially encountered, a monitoring well or piezometer will be installed if a minimum of 5 feet of water column can be maintained in the monitoring well/piezometer after it is placed in the well (but not completed with sand, bentonite, and grout). Monitoring well construction is illustrated in SOP 6806 (Appendix E).

After monitoring well installation is completed, each well and piezometer will be developed to remove fine-grained sediments and to stabilize the filter pack. Wells will be developed using bailing, pumping, surging, and/or air lift methods as described in SOP 6807 (Appendix E).

Drill cuttings will be collected from the entire depth of the borehole for each monitoring well for visual examination and field classification of soil types, as described in SOP 6805 (Appendix E). Drill cuttings will be screened in the field with an organic vapor analyzer (e.g., photo-ionization detector, or PID) using the

procedure described in SOP 6803 (Appendix E). Borehole cuttings generated during drilling and purge-water generated during well development will be managed as investigation-derived wastes, described in SOP 6808 (Appendix E).

2.6

TASK 5: GEOTECHNICAL EVALUATION

The objective of the geotechnical investigation is to assess the vertical subsurface profile in potentially developable areas of the Site, and analyze the physical properties of previously landfilled materials and the underlying and surrounding native soils. Information obtained from the geotechnical investigation will assist in remedy formulation and evaluation, and will also provide preliminary insight into potential re-use opportunities and/or constraints.

The geotechnical investigation will consist of soil borings and test pits/trenches. Geotechnical borings will be installed using hollow-stem auger drilling techniques as described in SOP 6809 (Appendix E). It is anticipated that the borings will be advanced 5 to 10 feet into the underlying native ground. Many of these locations will coincide with analytical soil sampling locations. Soil samples collected from several of the borings will be utilized for analytical laboratory testing (Section 2.9.1) in addition to geotechnical testing.

Where analytical sample locations are programmed and corresponding split-spoon samples at 5-foot increments are collected and inspected, additional thin-walled (Shelby) tube samples will also be collected within the 5-foot interval for geotechnical sampling. Two Shelby tubes will be collected from each geotechnical boring. Standard Penetration Test (SPT) blow counts will be recorded and split-spoon samples will be inspected and logged. Upon field inspection of the soils, one Shelby tube sample per soil boring will be selected to be tested for the following geotechnical parameters:

- Particle-Size Distribution with Hydrometer (American Society for Testing and Materials [ASTM] Method D-422);
- Atterberg Limits (ASTM D-4318);
- Moisture Content (ASTM D-2216);
- Bulk Density (ASTM D-4531); and,
- Soil Classification (ASTM D-2487).

Additional Shelby tube samples will be analyzed for one-dimensional consolidation (ASTM D-2435) and tri-axial shear strength (ASTM D-4767); the actual number and location of these samples and analyses will be specified in the MA-Specific Work Plans. Consolidation testing will be utilized to develop the parameters to calculate the anticipated magnitude and rate of settlement, while

the shear strength testing will evaluate the subsurface material response to loading. Sample depth, soil type, field conditions, and other physical characteristics will be considered when selecting the specific samples designated for geotechnical testing.

After completion of the geotechnical boring program, a Drilling Log (SOP 6805 – Appendix E) will be prepared for each boring to document the physical characteristics of each soil sample and field observations made during drilling and sampling. Additionally, descriptions of the soil samples will be logged in the field, and observations recorded in a bound fieldbook. Soil characteristics that will be logged based on visual examination of samples in the field are described in Section 2.5.1. Upon completion of each soil boring, the boring will be backfilled with soil cuttings to within approximately one foot of existing grade, as described in SOP 6804 (Appendix E).

The objective of installing test pits and trenches is to evaluate the presence of waste fill materials and to verify the delineated limits of a Source Area (see Figure 2). Test pits will be field located to correspond to the assumed limits of disposal, as presented in the MA-specific Work Plans. The test pits/trenches will be excavated to the depth obtainable using a standard backhoe; i.e., approximately ten (10) feet, and to the length and width required to reach that depth. The field geologist or engineer will record observations made during the test pit/trench investigation in a bound fieldbook. Observations based on visual examination of the test pit/trench and the excavated materials will be consistent with SOP 6805- Soil Description and Field Classification (see Appendix E).

Following completion of each test pit/trench, the material removed will be used to backfill the excavation. The backfill material will be placed in two (2)-foot thick lifts and uniformly compacted with the backhoe bucket; the resulting surface will be graded even with the surrounding area.

2.7

TASK 6: COVER SYSTEM THICKNESS EVALUATION

The objective of the cover system thickness evaluation is to identify those areas of prior waste disposal where cover soil has previously been installed above the waste material, and to assess the thickness of the cover soil. The results of the thickness assessment will be used to assist in remedy evaluation. To accomplish this objective, shallow borings, or probes will be installed throughout the Management Areas (and potential outside re-use areas) in order to determine if a cover soil layer is present above the waste fill material and, if so, the thickness of the cover soil layer.

The Site will be overlaid with a 200-foot by 200-foot grid (Figure 3) to assist in determining where the shallow borings should be installed. In each of the

Management Areas, one boring will be installed within each grid block; this corresponds to a frequency of approximately one (1) boring per acre. In potential re-use areas not located within a Source Area (see Figure 2), an average of 1 boring per two (2) acres will be advanced. The shallow borings will be installed using hand-auger or direct-push Geoprobe™ techniques (SOP 6801, 6802 – Appendix E). The Geoprobe™ technique will be used in readily accessible areas; i.e., no clearing required. In the remaining inaccessible areas, hand-auger techniques will be used. The depth of each boring will be a function of the technique employed. Specifically, the minimum boring depth will be in accordance with the following:

- Geoprobe™: five (5) feet; and,
- Hand auger: the lesser depth between: a) the depth to a definitive waste layer; or, b) three feet.

Upon completion of each shallow boring, the resulting borehole will be backfilled with soil cuttings to match the surrounding grade as described in SOP 6804 (Appendix E). If necessary, the remaining space will be backfilled to the ground surface with a cement/bentonite grout mixture.

2.8 TASK 7: STREAM GAUGING

2.8.1 *Monitoring Locations*

The monitoring locations for evaluating stream flow hydraulics and water quality will be described in the MA-Specific Work Plans; specifically, MA-F will discuss a tidal survey and surface water modeling. Each monitoring location will be surveyed to establish horizontal control. The location of the sampling station will be identified and marked using a GPS receiver, the general location relative to permanent landmarks will be recorded in the fieldbook. At several locations within the primary drainages, the channel geometry will be determined using standard survey methods, as described in SOP 6811 (Appendix E).

2.8.2 *Stream Flow Measurements*

Discharge measurements will be made at each of the designated streamflow monitoring locations along the primary drainages (e.g., Herring Run) according to the schedule to be outlined in the MA-Specific Work Plans. Stream discharge rates will be measured and calculated based on SOP 6811 (Appendix E).

To ensure that sufficient analytical data is available to document and support the human health and ecological risk assessments, supplemental soil, surface water, groundwater, leachate seep, sediment, soil-gas and biological samples will be required. Table 2-2 provides a summary of the number of historical and proposed samples for each environmental medium required to fulfill the risk assessments. The methods for collecting the proposed samples are described in the following sections.

2.9.1 *Soils*

Soil samples will be collected from the soil borings as described in Section 2.5.1 using the techniques outlined in SOPs 6800, 6801, 6802 and 6805. Analysis and handling of the samples is described in subsequent sections. The location of the sampling station will be identified and marked using a GPS receiver; the general location relative to permanent landmarks will be recorded in the fieldbook.

2.9.1.1 *Field Screening*

Each soil sample collected above the groundwater table will be screened in the field with an organic vapor analyzer (i.e., photo-ionization detector, or PID) at the time of sample collection utilizing a headspace method as described in SOP 6803 (Appendix E).

2.9.1.2 *Surface Soil*

Additional soil sampling for the RI will be conducted at the 0-6 inch surface soil depth. Soil data from 0-6 inches will be used in the ecological and the human health risk assessments. If during the field sampling there is an indication of contamination below this depth, deeper samples may be collected. Surface soils will be collected following SOP 6812 (Appendix E).

2.9.1.3 *Subsurface Soil*

The same precautions for the sampling of surface soils apply to subsurface soils.

The MA-Specific Work Plans will address the final locations and depths from which the samples will be obtained. Subsurface samples will be obtained by two methods: shallow subsurface sampling by hand-operated equipment and deep subsurface samples through the use of a drilling rig (i.e., hollow-stem auger or Geoprobe™) or a backhoe following SOPs 6800 and 6802 (Appendix E).

2.9.2 *Surface Water*

Prior to sampling, the surface-water drainage in and around the Site will be reviewed using all available, existing background information, including topographic maps and aerial photographs. An initial field survey of the Site will be conducted to identify sampling locations. This Site survey will aid in identifying any special equipment, personnel safety requirements, or procedures which may be necessary due to terrain or other factors specific to the Site. Also, stream characteristics, such as stagnation zones or mixing zones which might affect the distribution or volatilization of constituents in the water, will be noted and recorded in the fieldbook. Surface-water quality samples will be collected following SOP 6813 (Appendix E). The data will be used to assess the overall quality of the surface water and evaluate contaminant mass loading.

2.9.3 *Groundwater*

Groundwater samples will be obtained from two types of wells; monitoring wells or piezometers. The sampling protocols required are further divided into three subsections below: 1) water-level sampling; 2) well evacuation; and, (3) sample collection.

2.9.3.1 *Water-Level Sampling*

The majority of the monitoring wells sampled during this RI will have inside diameters of less than two inches; several existing on-Site wells may have larger diameters. Prior to well evacuation or sampling, the water level in all wells will be measured using SOP 6814 (Appendix E).

2.9.3.2 *Well Evacuation*

Monitoring wells and piezometers will be evacuated following the SOP 6816 (Appendix E).

2.9.3.3 *Sample Acquisition*

The procedure for sample acquisition from monitoring wells is outlined in SOP 6816 (Appendix E).

2.9.4 *Leachate Seeps*

Field personnel will collect a sample of overburden groundwater that seeps onto the ground surface if any such seeps are identified during the RI field activities; the procedure for sampling will follow SOP 6817 (Appendix E). Seep samples will be analyzed for the parameters delineated in Table 2-1. If possible, after sample collection, the pH, temperature, and conductivity of the seep water will

be measured and recorded using a YSI 600XL, or equivalent, meter. The location of the sampling station will be identified and marked using a GPS receiver; the general location relative to permanent landmarks will be recorded in the fieldbook.

2.9.5 *Sediment*

The primary aquatic environments; i.e., Herring Run, Moores Run, Redhouse Run and the upper reach of Back River, will be evaluated during the RI. Sediment sampling within these streams, and at select upstream and downstream locations, will discern whether there are Site-related exposures contributing to ecological risks. Because the streams are part of a larger urban watershed, information will be required relative to upstream conditions for each stream. Actual sampling locations will be selected based on physical depositional characteristics (i.e., particle-size distribution in the sediment); these will be presented and discussed in the MA-Specific Work Plans.

The sediment sampling protocol is described in SOP 6818 (Appendix E). Prior to sampling at a location, the sediment grabs, cores and all other sampling devices, such as spoons, will be decontaminated in accordance with procedures set forth in SOP 6819 (Appendix E).

2.9.6 *Soil-Gas*

The installation of soil-gas monitoring points will consist of Geoprobe™ boreholes with monitoring implants placed into the near surface, subsurface vadose zone a maximum depth of 5 feet. The stations will be monitored thereafter through tubing extending to the ground surface. The surface of the installation will be sealed with bentonite and grout, and covered for protection. The intent for these monitoring stations is to establish the concentrations of landfill gas (including VOCs, methanogens, and primary atmospheric gases) accumulating in the soil voids. The implants will remain in the ground to permit subsequent sampling on a periodic basis throughout the RI. The implants will be marked in the field and the location determined by the GPS receiver; the locations will be recorded in the fieldbook. The soil-gas implant procedure is included in SOP 6820 (Appendix E).

After installation, a small amount of soil vapor (landfill gas) will be purged from the implant to adequately flush the sampler and line. The subsurface gas implants will then be capped to ensure that no moisture enters the tubing, and allowed to equilibrate at least overnight prior to sampling. Each monitoring station will be analyzed in the field for temperature, pressure, methane lower explosive limit (LEL) percentage, hydrogen sulfide, ammonia, VOCs, and oxygen using a BW Technology Gas Alert Micro 5 PID (or similar) following SOP 6822

(Appendix E). In addition, samples of the soil gas will be obtained using Summa canisters for laboratory analysis of the gaseous constituents as described in SOP 6822 (Appendix E). A full scan (TO-15i) of volatile constituents will be evaluated in the laboratory in addition to the replication of the field parameter results.

2.9.7 *Biological*

Biological sampling and analysis includes a reconnaissance survey and follow-up sampling event comprised of fish tissue sample collection, a qualitative benthic survey, and the collection of samples for sediment toxicity testing. The collection of samples for sediment toxicity testing will be coordinated with the sediment sampling survey (see Section 2.9.5).

2.9.7.1 *Reconnaissance Survey*

A reconnaissance and habitat survey will yield a list of habitats from which the fish tissue sampling program will be refined. This survey will incorporate the input of federal and/or state agency personnel in establishing existing conditions and finalizing sample locations. The habitat survey will include a general description of the habitats present and their use by species at the time of the survey. The locations and limits will be presented on a map. The field observations will additionally be used to finalize sampling methodology and the number of biota samples that can be realistically collected in a single sampling event. The objectives, procedures, and justification for the reconnaissance survey activities are described in SOP 6824 (Appendix E).

2.9.7.2 *Fish Collection*

Fish samples will be collected to meet two objectives: 1) identification of predominant species; and, 2) evaluation of levels of bioaccumulative compounds in tissues. Sampling is anticipated to occur in three areas: Herring Run upstream of the I-95 bridge (Upstream); Herring Run from the I-95 bridge to the Amtrak Railroad bridge (including Moores Run) (Site); and from the Amtrak Railroad Bridge to the I-695 bridge (Downstream) (Figure 2). The fish samples will be collected following SOP 6824 (Appendix E).

2.9.7.3 *Collection of Benthic Community Samples*

Benthic community samples will be obtained at the sediment sampling locations for the Site reaches for qualitative analysis. These collections are not used to

ⁱ This method was prepared for publication in the *Compendium of Methods for the determination of Toxic Organic Compounds in Ambient Air, Second Edition* (EPA/625/R-96/010b).

compare areas with respect to potential impacts due to the heterogeneity of this particular environment. Rather, these samples will be used to develop an understanding of the types of benthic receptors present throughout the area. These qualitative samples will be obtained at select sampling stations in the runs above, within, and below the Site. Because, these samples will be for qualitative purposes only, one sample will be obtained at each location for identification of taxa. Two possible sampling methods will be employed, depending on habitat. Grab samples will be used where sediments are comprised of silts and sands. Surber samples will be used where sediments are comprised of gravel, rocks, and debris. Both methods are outlined in SOP 6824 (Appendix E) for sediment collection.

Habitat conditions at each of the sample locations will be evaluated in the field and by several of the analytical measurements made in the laboratory. For each fish sample collection and benthic community station, the following parameters will be determined: physical characteristics of sediments (i.e., field observations and particle-size distribution analysis), organic content of sediments (i.e., field observations on the nature of the sediments and laboratory measurements of total organic carbon), water depth, stream flow velocity (as projected or measured in the field), width of surface-water body, characteristics of shoreline, bordering vegetation, and extent of overhanging vegetation. Observations for the habitat assessment will be guided by the United States Environmental Protection Agency (USEPA) *Habitat Assessment Field Data Sheet-Low gradient Streams*, USEPA Rapid Bioassessment Protocols, 1989.

2.9.8 QA/QC Samples

Analytical data cannot be properly assessed for accuracy and precision unless it is accompanied by quality assurance data. The quality control samples used to measure accuracy and precision are summarized below. The selection and frequency of quality control samples is described in greater detail in the QAPP, but a brief summary is provided below.

Field Internal Quality Control Checks will be utilized during this investigation through the application of the following:

- Trip Blanks: Consists of analytically pure water or solid in containers identical to those used for samples. The empty sample containers are filled prior to sampling, carried with the collected samples, and returned to the laboratory for analysis. These samples should be submitted to the laboratory using a fictitious sample location so they are "blind" to the laboratory. Trip blanks should be analyzed exactly as are the

environmental samples submitted on a day when VOC samples are collected. Trip blanks will be submitted using a fictitious ID at a rate of one per sample day to serve as an indicator of container cleanliness, external contamination, and contamination from analytical procedures.

- Equipment Rinsate Blank: Equipment rinsate blanks will be collected to ensure that the sampling equipment is clean and that the potential for cross contamination has been minimized by the equipment decontamination procedures. These blanks will be collected by decontaminating the sampling device and then pouring ultra-pure deionized water over the device. This rinsate water will be collected into a clean stainless steel bowl and then transferred to the appropriate sample containers. One equipment rinsate blank will be collected for each sampling device associated with the soil, groundwater, surface water/seep and sediment samples. A solid sampling equipment rinsate blank will be collected for split-spoon samplers, hand augers, spoons, etc. The equipment rinsate blanks will be submitted using a fictitious sample ID and analyzed for identical parameters as the associated samples. Equipment rinsate blanks will be collected from each sampling device, at a frequency of one per 20 samples or one per sampling event, whichever is more frequent.
- Field Blank: Field blanks will be collected to ensure that sample containers are clean. These blanks will be collected by pouring ultra-pure deionized water into the sample container in the field. Field blanks will be collected for each medium sampling event at a frequency of one per 20 samples or one per sampling event, whichever is more frequent. The field blanks will be submitted using a fictitious sample ID and analyzed for identical parameters as the associated samples.
- Matrix Spike Sample: Matrix spike/matrix spike duplicate (MS/MSD) samples will also be submitted as further quality control (QC) checks. These samples will be spiked by the laboratory, and will be collected at the frequency of one MS and MSD for every 20 field samples. These samples will allow accuracy to be determined by the recovery rates of compounds (the matrix spike and/or surrogate spike compounds defined in the analytical methods). Precision will also be assessed by a comparison of matrix spike and matrix spike duplicate recoveries. The purpose of the laboratory spikes is to monitor any possible matrix effects specific to samples collected from the Site. The addition of known concentrations of compounds/constituents into the sample also monitors extraction/digestion efficiency.

- Field Duplicate Samples: Field duplicate samples will be collected to allow the determination of analytical and sampling precision. One field duplicate sample will be collected for every 20 soil, sediment, groundwater, and surface water/seep samples and submitted using a fictitious sample ID for analysis of the identical parameters as the associated sample.

3.0 *SAMPLE HANDLING*

Each sample collected during the RI will be assigned a unique sample identification number as previously described in Section 2.1.2.

3.1 *SAMPLE PREPARATION*

Biological samples will be collected (Section 2.9.7.2), wrapped in aluminum foil and then placed in a zippered plastic bag. Once sealed, the sample will be placed in a cooler with dry-ice and shipped to the appropriate laboratory (STL-Burlington).

3.2 *SAMPLE PRESERVATION*

Preservation methods will be limited to pH control, chemical addition (e.g., ethanol for invertebrate samples, nitrate for water samples for metals analyses, etc.), refrigeration, and freezing. Table 2-1 displays the recommended volume sizes, container types, preservatives, and holding times for a variety of water - quality parameters. The sample bottles supplied by the laboratory will be preserved before delivery to the field and placed in a cooler with ice as soon as possible after sampling.

3.3 *SAMPLE STORAGE*

Sample bottles will be supplied by the laboratory conducting the analysis. Once the sample is collected, it will immediately be placed on ice to maintain a temperature of 4° Centigrade (C) for each sample. It is critical that aqueous samples for volatile organic samples be collected in 40 milliliter (mL) vials, and that no air is trapped inside the vial after the sample has been collected. Table 2-1 provides a list of recommended sample containers, volumes, preservatives, special handling and holding times.

3.4 *PACKAGING AND SHIPPING PROCEDURES*

After the samples have been collected, prepared, preserved, and appropriately stored, each must be packaged for shipment and/or delivery to the designated laboratory. SOP 6827 (Appendix E) outlines procedures for the packing and shipping of environmental samples. In addition, from the time of sample collection until the analyses have been completed, chain-of-custody procedures must be followed to ensure the proper handling and possession of the samples, in accordance with SOP 6826 (Appendix E).

CHAIN OF CUSTODY

The chain-of-possession and custody of any samples which form the basis of analytical test results must to be maintained. Written procedures (SOP 6826 – Appendix E) will be followed whenever samples are collected, transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate written record which can be used to trace the possession and handling of the sample from the moment of its collection, through analysis, and use in the database. The SOP for chain of custody procedures will be followed at all times.

ANALYTICAL PROCEDURES

Sampling containers and appropriate preservatives are based on the analyses to be performed on each sample. A comprehensive list of sample containers, preservatives and holding times for each type of chemical analysis included in the analytical laboratory program is presented in Table 2-1. Appropriate sample containers will be used for the analyses to be performed on each sample collected during this task, by medium and analytical parameter. Requirements for the documentation of sampling and sample handling are presented in Section 3.0.

Quality control samples to be incorporated into the analytical laboratory program include trip blanks, field blanks, equipment rinsate blanks, blind duplicates, and matrix spike/matrix spike duplicates (MS/MSD). The specific quality control samples for each sampling task will be identified for each sampling task in the MA-Specific Work Plans.

One trip blank for VOCs will be submitted per cooler for each day that Site samples are collected for VOC analysis. If no samples are collected for VOC analysis during a given day of sampling, VOC trip blanks will not be submitted. Blind duplicate samples will be submitted at a frequency of 1 each per 20 Site samples submitted to the laboratory, and will be analyzed for the same analytes as the associated samples. Field blanks, equipment rinsate blanks, and MS/MSD samples will also be collected and submitted at a rate of 1 each per 20 Site samples. The field blanks, equipment rinsate blanks, and MS/MSD samples will be analyzed for the same analytes as the associated samples.

5.0 DECONTAMINATION PROCEDURES

5.1 DRILLING EQUIPMENT DECONTAMINATION

Drilling equipment will be decontaminated prior to initial use, between boring locations, and at the completion of drilling activities as outlined in SOP 6819 (Appendix E).

5.2 SAMPLING EQUIPMENT DECONTAMINATION

All non-disposable equipment used for the collection, preparation, preservation, and storage of environmental samples must be cleaned prior to use and after each subsequent use. Unless the equipment and materials being used are disposable or of sufficient number so as not to be reused during any one sampling period, decontamination must be conducted in the field following SOP 6819 (Appendix E). If possible, dedicated or disposable equipment should be used to minimize field decontamination requirements.

6.0

INVESTIGATION-DERIVED MEDIA

All investigation-derived media generated during drilling, sampling and decontamination activities for all media will be handled in accordance with SOP 6808 (Appendix E). The Coalition will assume the responsibility of generator for the disposal of any resultant designated wastes.

7.0 FIELD EQUIPMENT

Field personnel will maintain and calibrate equipment to ensure that accurate data are collected during field investigations with minimal equipment problems. Routine maintenance and calibration schedules have been established for all field equipment and instruments, according to manufacturer recommendations and equipment applications.

7.1 MAINTENANCE PROGRAM

7.1.1 Field Maintenance

Routine daily maintenance procedures must be conducted in the field to ensure that the equipment is operable and accurate. Routine daily maintenance procedures conducted in the field will include the following:

- Removal of surface soil and debris from exposed surfaces of the sampling equipment and measurement systems;
- Replacement of disposable parts (i.e., filters, probe membranes, etc) as required by equipment manual;
- Storage of equipment in a secure, dry place, protected from dust, wind, and precipitation;
- Daily inspections of equipment and instruments for possible problems (e.g., cracked or clogged lines or tubing, weak batteries);
- Checking of instrument calibrations as described in the equipment manual; and,
- Charging battery packs for equipment when not in use, or when necessary.

The equipment operator will ensure that appropriate replacement parts accompany all equipment to the field.

7.2 CALIBRATION PROCEDURES

Equipment calibration ensures that measurements obtained accurately reflect the known standard. Field personnel will calibrate equipment/ instrumentation as recommended by the manufacturer in the equipment manual. Calibration solutions will be dated, and only such valid solutions will be used.

Tables

Section 2.0 - Field Methodology
Table 2-1 Sample Analysis Summary

Matrix	Analyses	Method	Bottle Ware	Preservation	Holding Times	Laboratory
Water	VOCs	8260B	GL - 40 (3) mL vial	HCL, Cool 4°C	14 days	STL-Pittsburgh
(Ground Water,	SVOCs	8270C	GL - 1L	Cool 4°C	7 days	STL-Pittsburgh
Surface Water,	Pesticides/PCBs	8081A / 8082	GL - 1L	Cool 4°C	7 days	STL-Pittsburgh
Leachate Seeps)	Herbicides	8151A	GL - 1L	Cool 4°C	7 days	STL-Pittsburgh
	Dioxins/Furans	8290	GL - 1L	Cool 4°C	Extraction within 30 days, analysis within 45 days	STL-Knoxville
	Metals + mercury	6010B / 7470A	PL - 250mL	HNO ₃ , Cool 4°C	6 months	STL-Pittsburgh
	Hexavalent chromium	7196A	PL - 250mL	HNO ₃ , Cool 4°C	24 hours	STL-Pittsburgh
	Total cyanide	9012A	PL or GL -1L	NaOH, Cool 4°C	14 days	STL-Pittsburgh
	Total phenolics	9066	GL -1L	H ₂ SO ₄ , Cool 4°C	28 days	STL-Pittsburgh
	Total phosphorus	365.1	PL or GL / 100ml	H ₂ SO ₄ , Cool 4°C	48 hours	STL-North Canton
	Nitrate/Nitrite	353.2	PL or GL / 100ml	Cool 4°C	28 days	STL-Pittsburgh
	Ammonia Nitrogen	350.1	PL or GL / 250ml	H ₂ SO ₄ , Cool 4°C	28 days	STL-Pittsburgh
	Total Alkalinity	310.1	PL or GL / 100ml	Cool 4°C	14 days	STL-Pittsburgh
Soil	VOCs	8260B	5 gm Encore Sampler (set of 3)	Cool 4°C	48 hours	STL-Pittsburgh
Soil	SVOCs	8270C	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Pesticides/PCBs	8081A / 8082	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Herbicides	8151A	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Dioxins/Furans	8290	GL 4oz. wide mouth	Cool 4°C	Extraction within 30 days, analysis within 45 days	STL-Knoxville
	Metals + mercury	6010B / 7470A	GL 4oz. wide mouth	Cool 4°C	6 months-28 days	STL-Pittsburgh
	Hexavalent chromium	7196A	GL 4oz. wide mouth	Cool 4°C	24 hours	STL-Pittsburgh
	Total cyanide	9012A	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Total phenolics	9066	GL 4oz. wide mouth	Cool 4°C	28 days	STL-Pittsburgh
	Percent moisture	160.3	GL 4oz. wide mouth	--	--	STL-Pittsburgh
Sediment	VOCs	8260B	GL 4oz. wide mouth	Cool 4°C	48 hours	STL-Pittsburgh
Sediment	SVOCs	8270C	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Pesticides/PCBs	8081A / 8082	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Herbicides	8151A	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Dioxins/Furans	8290	GL 4oz. wide mouth	Cool 4°C	Extraction within 30 days, analysis within 45 days	STL-Pittsburgh
	PCB homologs / Congeners	Modified 8270 / 8082	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Metals + mercury	6010B / 7470A	GL 4oz. wide mouth	Cool 4°C	6 months-28 days	STL-Pittsburgh
	Hexavalent chromium	7196A	GL 4oz. wide mouth	Cool 4°C		STL-Pittsburgh
	Total cyanide	9012A	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Total phenolics	9066	GL 4oz. wide mouth	Cool 4°C	28 days	STL-Pittsburgh
	AVS / SEM	EPA AVS/SEM SOP Version 2.0 (3)	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	TOC Lloyd Kahn	Plumb, 1981 Method (1)	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Burlington
	Carbon Black	Accardi-Dey & Gschwend, 2003 Method (2)	GL 4oz. wide mouth	Cool 4°C	28 days	STL-Pittsburgh
	ASTM - grain size	ASTM D4139	GL 4oz. wide mouth	--	--	STL-Pittsburgh

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Section 2.0 - Field Methodology
Table 2-1 Sample Analysis Summary

Matrix	Analyses	Method	Bottle Ware	Preservation	Holding Times	La
	Chironomous tentans - 10 day toxicity test	EPA Method 100.2 (4)	GL 4oz. wide mouth	Cool 4°C	28 days	Aquat
	Hyalella azteca - 28 day toxicity test	Modified EPA Method 100.4 (5)	GL 4oz. wide mouth	Cool 4°C	28 days	Aquat
	Percent moisture	160.3	GL 4oz. wide mouth	--	--	
Tissue						
Fish	Percent lipids		Wrapped in aluminum foil and then plastic ziplock	Deep frozen and shipped in dry-ice	28 days	STL-
	PCB homologs / Congeners	Modified 8270 / 8082	Wrapped in aluminum foil and then plastic ziplock	Deep frozen and shipped in dry-ice	14 days	STL-
	Pesticides	8081A	Wrapped in aluminum foil and then plastic ziplock	Deep frozen and shipped in dry-ice	14 days	STL-
	Mercury	7471A	Wrapped in aluminum foil and then plastic ziplock	Deep frozen and shipped in dry-ice	28 days	STL-
Air						
Soil gas	VOCs	TO-15	6-liter SUMMA canister	capped securely	28 days	STL-
	Mercury	Modified 7471A (NIOSH 6009)	Hopcalite Tube	Cool 4°C tube capped and taped securely	28 days	STL -

References:

- (1) Plumb, RH Jr., 1981. Procedure for handling and chemical analysis of sediment and water samples. Technical Report EPA/CE-81-1, Vicksburg, MS: USEPA/USACE Technical Committee on criteria for dredged and fill material, US Army Waterways Experimental Station.
- (2) Accardi-Dey, A. and Gschwend, P.M., 2003. Reinterpreting Literature Sorption Data Considering both Absorption into Organic Carbon and Adsorption onto Black Carbon. Environ. Sci. Technol. 37:99-106.
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Section 2.0 - Field Methodology

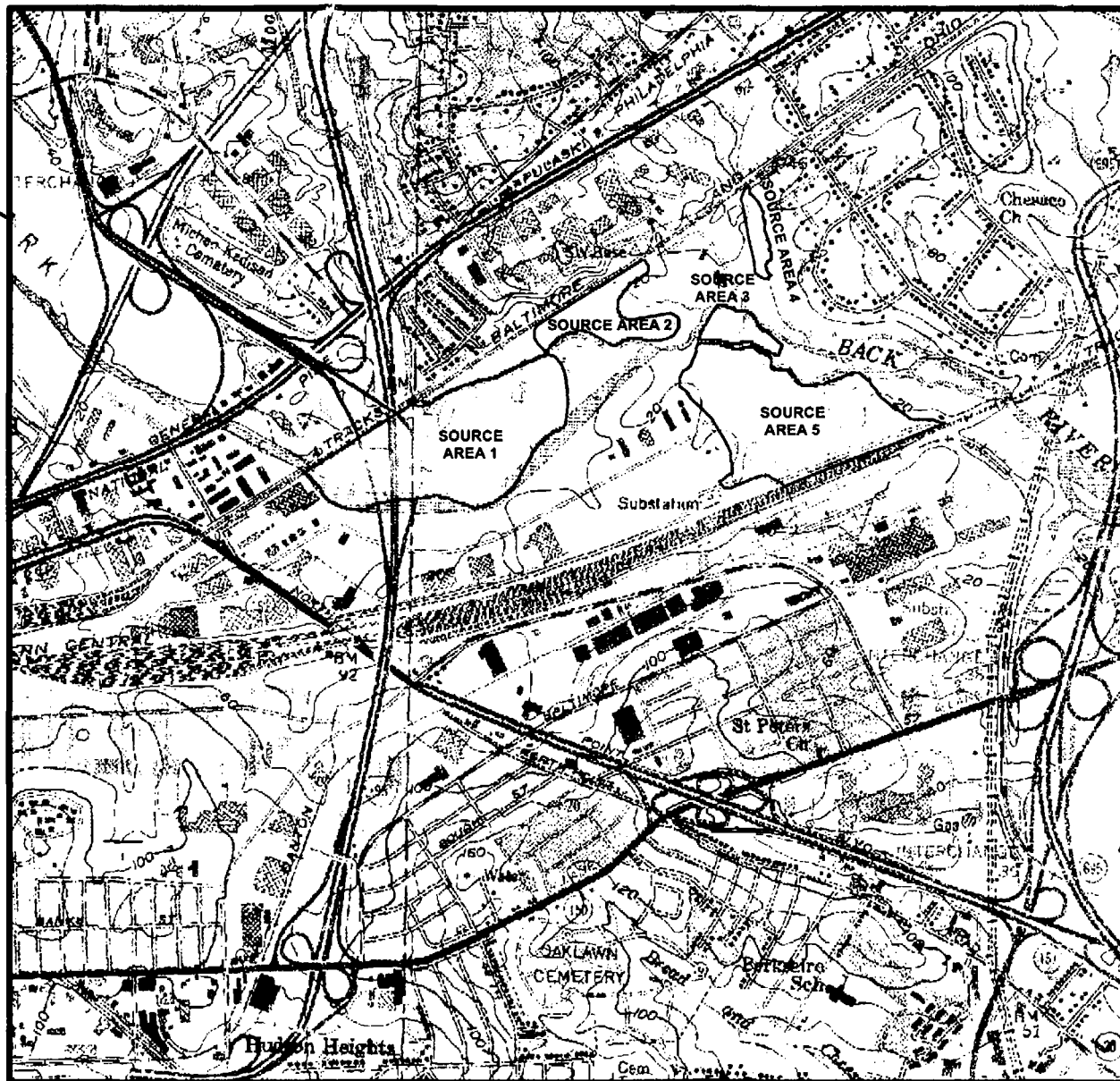
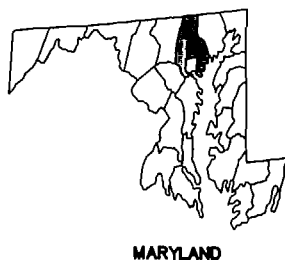
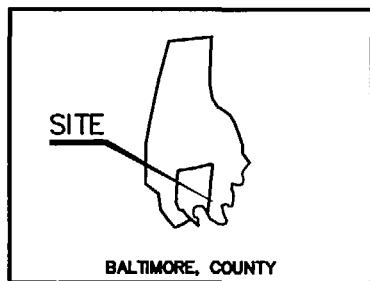
Table 2-2 Summary of Historical and Proposed Samples for Each Enviromental Medium

Medium	Historical Samples	Proposed Samples ^e	Total Samples
Soil	54	40 ^a	94
Sediment	76	8	84
Ground Water	31	43	74
Surface Water	60	7	67
Soil Gas	0	41	41
Leachate Seeps ^b	0	28	28
Waste ^c	103	---	103
Biota Survey ^d	0	9/4 ^d	9/4 ^d

Notes:

- a. Includes 8 samples from off-site locations for comparison to background concentrations.
- b. Number of proposed leachate samples will be confirmed following identification of leachate seeps during the Remedial Investigation.
- c. Waste includes: slag, drums, unidentified waste materials, and all historical soil samples below 2 ft below grade.
No new waste samples are being proposed at this time.
- d. Proposed Biota Survey includes 9 sampling locations for stream benthic invertebrate diversity sampling, and 4 estimated locations for fish capture for bioassay analysis.
- e. Includes 10% re-analysis of historical samples plus new samples. If the number of histoical samples was greater than zero, but less than 10, then a minimum of 1 sample would be reanalyzed. Quality Assurance/Quality Control samples are not included.

Figures



ADAPTED FROM USGS
BALTIMORE EAST/1953-PHOTOREVISED/1966/1974



Environmental Resources
Management, Inc.

June 18, 2007



Scale in Feet
1" = 2,000'

FIGURE 1
Site Location Map
68th Street Landfill Site
Rosedale, Maryland



Environmental Resources
Management, Inc.

June 18, 2007



Scale in Feet
1" = 600'

0 300 600 Feet

Legend:



USEPA-Defined Source Areas

Existing Developed Land

FIGURE 2
General Plan
68th Street Landfill Site
Rosedale, Maryland



Environmental Resources
Management, Inc.

June 18, 2007



Scale in Feet
1" = 600'

0 300 600
Feet

Legend:



Management Areas (MA) A-E

Management Area F

USEPA-Defined Source Areas

Existing Developed Land

FIGURE 3
Grid Plan
68th Street Landfill Site
Rosedale, Maryland

Appendix B
Quality Assurance Project Plan

Quality Assurance Project Plan

68th Street Landfill Site Rosedale, Maryland

Prepared for:
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Suite 2800
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Prepared by:
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200 Harry S Truman Parkway
Suite 400
Annapolis, Maryland 21401


June 18, 2007

Quality Assurance Project Plan

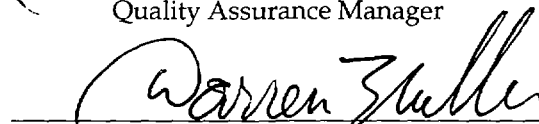
68th Street Landfill Site
Rosedale, Maryland

June 18, 2007

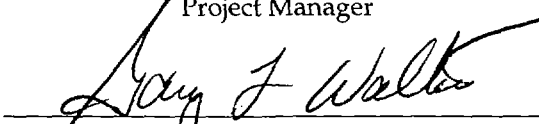
ERM Project No.: 0049608



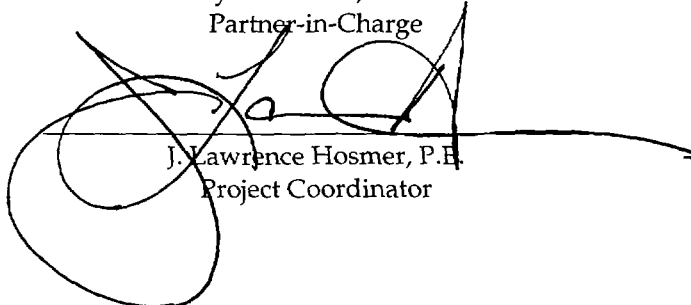
Connie Faustini *for:*
Quality Assurance Manager



Darren Quillen, P.E.
Project Manager



Gary L. Walters, CHMM
Partner-in-Charge



J. Lawrence Hosmer, P.E.
Project Coordinator

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A LABORATORY QUALITY MANUAL CD

INTRODUCTION

The 68th Street Sites Coalition (Coalition) is conducting a Remedial Investigation/ Feasibility Study (RI/FS) of the 68th Street Landfill Site (Site) located in Rosedale, Baltimore County, Maryland. This Quality Assurance Project Plan (QAPP) is a project control document prepared to support implementation of the Statement of Work (SOW) included as Appendix C to the Administrative Settlement Agreement and Order on Consent (ASAOC), as specified in the Site Wide Program Management Plan (SWPMP) dated November 15, 2006. The QAPP is one component of the Site-Wide Work Plan (SWWP) which will be applied to all field activities conducted at the Site. Specifically, the Site-wide QAPP presents the quality assurance measures that will be used in concert with the Field Sampling Plan (FSP), which identifies the sample collection procedures. The FSP, presented as Appendix A to this SWWP, provides the universally applicable information necessary to properly conduct data collection and sampling activities that generate data of acceptable quality and that exceed the minimum standards of the risk assessment and feasibility study. It should be noted, however, that Management Area-Specific Work Plans will provide additional details on the sample locations, depths and analyses for each specific sample prescribed.

This QAPP has been prepared based on guidance presented in the U.S. Environmental Protection Agency (USEPA) document entitled: "Guidance for Quality Assurance Project Plans", EPA QA/G-5 (EPA/240/R-02/009, December 2002) and fulfills the requirements set forth in the ASAOC. Other project control documents related to the implementation of the RI at the Site include the following:

- Remedial Investigation/Feasibility Study Field Sampling Plan for the 68th Street Landfill Site, Rosedale, Baltimore County, Maryland, (FSP) (2006) – Appendix A;
- Remedial Investigation/Feasibility Study Health and Safety Plan for the 68th Street Landfill Site, Rosedale, Baltimore County, Maryland, (HASP) (2006) – Appendix C; and,
- Remedial Investigation/Feasibility Study Risk Assessment Work Plan for the 68th Street Landfill Site, Rosedale, Baltimore County, Maryland, (RAWP) (2006) – Appendix D.

A description of the site background, history, and previous studies is presented in the SWPMP, and therefore not reiterated herein.

PURPOSE

The purpose of the QAPP is to provide a description of the methods and procedures for environmental analytical laboratory activities to be performed during implementation of the field activities as presented in the FSP. These protocols will consist of methods and procedures for:

- the collection, documentation, custody, handling and shipment of environmental samples;
- chemical analyses to be performed on the samples derived from each medium of concern;
- surface geophysical surveys, soil borings, soil sampling, monitoring well installation, water level monitoring, and the collection of groundwater, leachate seep, surface-water and sediment samples; and,
- equipment decontamination.

The primary sampling and analysis objectives are to collect data of sufficient quality and quantity in order to define the nature and extent of Site contamination to the degree necessary to permit the performance of a risk assessment and a feasibility study of alternatives for final Site remediation. Data collection efforts presented in the Field Sampling Plan (FSP) are focused on collecting those data necessary to fill the data gaps identified in the SWPMP (Section 3.0). The sampling objective will be accomplished by implementing the scope presented in the overall SWWP using the methods and procedures described in the FSP while conforming to the HASP, RAWP, and QAPP.

Supplemental Site activities are detailed in the FSP but are not included in the QAPP. These activities include the following:

- review of historical aerial photography;
- topographic survey to generate a Site base map; and,
- management of investigation-derived wastes.

2.0

PROJECT ORGANIZATION AND RESPONSIBILITIES

While all personnel involved in the project are implicitly responsible for overall product quality assurance, certain individuals have been specifically delegated oversight responsibilities for these activities. For the 68th Street Landfill Site, these individuals include the Project Coordinator, the Project Manager, the Field Task Manager, the Quality Assurance (QA) Manager, Field Personnel, and the Laboratory Quality Assurance Manager(s). These individuals are identified below, and comprise the distribution list for the QAPP and other project control documents.

Severn Trent Laboratories (STL) of Pittsburgh, Pennsylvania will serve as the primary environmental analytical laboratory for the project. Certain chemical analyses will be conducted at other laboratory locations within the STL network, based on specialization of the laboratory. Further, biological (toxicity) testing will be provided by Aquatec Biological Sciences of Williston, Vermont. Each of the laboratories providing analytical support for the RI/FS has current certifications under the National Environmental Laboratory Accreditation Program.

Geotechnical laboratory analyses will be conducted by JLT Laboratories, Inc. (JLT) of Canonsburg, Pennsylvania. These analyses will be used to derive physical parameters for the subsurface materials encountered.

2.1

PROJECT COORDINATOR

Mr. J. Lawrence Hosmer, P.E. will serve as the Project Coordinator. As Project Coordinator, he will be responsible for all activities conducted at the Site under the ASAO on behalf of the Coalition. Mr. Hosmer will be the primary contact with the USEPA Remedial Project Manager, Mr. Christopher J. Corbett.

2.2

PROJECT MANAGER

Mr. Darren Quillen, P.E. will serve as the Project Manager. As Project Manager, he is responsible for assigning and managing the resources applied to the project, coordinating staff and work activities, reviewing quality and performance for each task, and ensuring that the technical, financial, and scheduling aspects of the project meet the stated objectives. The Project Manager also serves as a point-of-contact and control for planning and implementing work tasks, and reports to the Project Coordinator.

FIELD TASK MANAGER

Mr. Nathaniel Warner, P.G. will serve as the Field Task Manager. As the Field Task Manager, Mr. Warner is responsible for preparing the field components of the Management Area-Specific Work Plans, overseeing the field activities, and contributing to the resultant RI reports. His duties will include scheduling analytical services and informing the laboratory of sample shipment. He will also be responsible for communicating with the laboratory on an agreed schedule to ensure that all samples have been received and have been transferred to the laboratory for the conduct of the specified analyses. After the analyses are complete, he will be responsible for tracking and filing documentation returned from the laboratory and will forward analytical data to the QA Manager for validation review. Mr. Warner will report directly to the Project Manager.

QUALITY ASSURANCE (QA) MANAGER

Ms. Connie Faustini will serve as the Quality Assurance Manager. As the QA Manager, she will be responsible for all QA aspects of the project, including all QA/QC protocols in the field, office and laboratory. The QA Manager will oversee the implementation of the QAPP, ensure that the internal QA measures are conducted, and oversee the data validation process. Ms. Faustini will report directly to the Project Manager.

FIELD PERSONNEL

All sampling activities will be conducted by experienced environmental, hydrogeologic, or geotechnical field personnel. Their responsibilities will include the documentation of the proper sample collection protocols, sample collection and field measurements, equipment decontamination, and chain-of-custody documentation. The field personnel will be organized by teams which report to the Field Task Manager.

ANALYTICAL LABORATORY QUALITY ASSURANCE MANAGER

Mr. Ken Ives (STL) will serve as the Analytical Laboratory Quality Assurance Manager. Mr. Ives, located in Baltimore, Maryland convenient to the Site, will be the primary point-of-contact for analytical services. Mr. Ives will be responsible for maintaining all laboratory quality assurance activities related to the project and will ensure that all samples are appropriately labeled, packaged and shipped to the appropriate Severn Trent Laboratory. He will also be available to provide status updates on samples that have been received at the various analytical laboratories.

3.0

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

3.1

OVERALL PROJECT OBJECTIVES

Data Quality Objectives (DQOs) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision-making process. DQOs define the total uncertainty in the data that is acceptable for each specific activity during the field sampling program. This uncertainty includes both sampling error and analytical error. Ideally, zero uncertainty is the intent; however, the variables inherently associated with the process (field and laboratory) contribute to uncertainty in the data. It is the overall project objective to retain total uncertainty within an acceptable range that will not hinder the intended use of the data. In order to achieve this objective, data quality requirements such as quantitation limits, criteria for accuracy and precision, sample representativeness, data comparability, and data completeness have been specified. The overall data quality objectives and requirements will be established such that there is a high degree of confidence in measurements performed during the project. Ultimately, the data will be compared to risk-based ecological and human health screening levels which will be used to determine future development potential at the Site.

As previously stated, the parameters that will be used to specify data quality requirements and to evaluate analytical system performance are precision, sensitivity, accuracy, representativeness, completeness, and comparability (PSARCC). Table 3-1 presents definitions for these parameters.

Table 3-1. Definitions of Data Quality Parameters

Parameter	Description
Precision	A measure of the reproducibility of measurements under a given set of conditions.
Sensitivity	Expressed in terms of reporting limits. Defined by the ability of the method and instrument to detect target compounds/analytes at the required levels.
Accuracy	A measure of the bias that exists in a measurement system.
Representativeness	The degree to which sample data accurately and precisely represents selected characteristics.
Completeness	A measure of the amount of valid data obtained from the measurement system compared to the amount that is required.
Comparability	A measure of confidence with which one data set can be compared with another.

SAMPLING EFFORT QUALITY OBJECTIVE

The objective with respect to the sampling effort is to maximize the confidence in the data in terms of PSARCC. Section 9.0 of this QAPP presents the frequency with which trip blanks, field duplicates, equipment blanks, field blanks, and matrix spikes will be collected such that a specific degree of precision and accuracy can be calculated. The data quality objective for field duplicates is to achieve precision equal to or greater than that summarized in Table 3-2.

Precision will be calculated as the relative percent difference (RPD) if there are only two analytical points, and as relative standard deviation (RSD) if there are more than two analytical points. The submission of trip blanks, equipment blanks, and field blanks will provide a check on accuracy. Although accuracy is best assessed by evaluating the results of blanks, blanks do not monitor analyte losses. The submission of blanks will, however, monitor contaminants introduced by the sampling process, preservation, handling, shipping, and the analytical process. The data quality objective for trip blanks and field blanks is to meet or exceed the laboratory Reporting Limit (RL). Through the submission of field QC samples, distinctions can be made between laboratory problems, sampling techniques, and sample matrix variability.

Table 3-2. Criteria Objectives

Objectives		Aqueous	Solid/Air/Other
Precision			
Field Duplicate/Replicates (Blind or labeled)			
VOCs		within 20% RPD	within 30% RPD
SVOCs		within 25% RPD	within 40% RPD
Pesticides/PCBs		within 25% RPD	within 40% RPD
Herbicides		within 25% RPD	within 40% RPD
Dioxins/Furans		within 25% RPD	within 40% RPD
Metals		within 25% RPD	within 40% RPD
Misc. Parameters		within 25% RPD	within 40% RPD
Laboratory Duplicate (Unspiked and MSD)			
VOC		Laboratory QC limits	Laboratory QC limits
SVOCs		Laboratory QC limits	Laboratory QC limits
Pesticides/PCBs		Laboratory QC limits	Laboratory QC limits
Herbicides		Laboratory QC limits	Laboratory QC limits
Dioxins/Furans		Laboratory QC limits	Laboratory QC limits
Metals		Laboratory QC limits	Laboratory QC limits
Misc. Parameters		Laboratory QC limits	Laboratory QC limits
Accuracy			
Field, Equipment, or trip blanks			
VOCs, SVOCs, Pesticides/PCBs, Herbicides, Dioxins/Furans Metals		Less than the RL	Less than the RL
Misc. Parameters		Less than the RL	Less than the RL
Laboratory Blanks			
VOCs, SVOCs, Pesticides/PCBs, Herbicides, Dioxins/Furans Metals		Less than the RL	Less than the RL
Misc. Parameters		Less than the RL	Less than the RL
Matrix spikes/surrogate spikes/Laboratory Control Samples			
All Analyses		Laboratory QC limits	Laboratory QC limits

Notes:

VOCs - Volatile Organic Compounds

SVOCs - Semi-volatile Organic Compounds

PCBs - Polychlorinated biphenyls

Laboratory QC limits - Laboratory Quality Control Limits

RL - Reporting Limit

MSD - Matrix Spike Duplicate

RPD - Relative Percent Difference

Precision and accuracy for the field parameter measurements (i.e., pH, dissolved oxygen, salinity and specific conductivity) are dependent on the type and condition of the instrument used and the care taken in the standardization and operation. The precision and accuracy objectives for the instrumentation used are as follows:

- pH precision will be ± 0.3 pH standard units and accuracy will be ± 0.03 pH standard units. pH measurements will be reported to two significant figures.
- Specific conductivity precision will be ± 3 $\mu\text{mhos/cm}$ on the 500 $\mu\text{mhos/cm}$ range, ± 25 $\mu\text{mhos/cm}$ on the 5,000 $\mu\text{mhos/cm}$ range, and ± 250 $\mu\text{mhos/cm}$ on the 50,000 $\mu\text{mhos/cm}$ range. Accuracy for the conductivity measurements is a function of the conductivity reading for the probe and instrument combined. The accuracy will be ± 25 percent (%) at 500, 50, and 5.0 $\mu\text{mhos/cm}$, and $\pm 30\%$ at 250, 25, and 2.5 $\mu\text{mhos/cm}$. Conductivity measurements include accuracy criteria, and will be reported to one significant figure for values below ten and to two significant figures for values above ten.
- Dissolved oxygen (DO) precision will be ± 0.1 mg/L and accuracy will be ± 0.2 mg/L. When performing the DO test, the measurement probe will be located inside of the well or in an in-line water quality monitoring device (flow-through cell). Therefore, this is a field test that will be performed on Site.
- Salinity precision will be $\pm 3\%$ and salinity accuracy will be $\pm 5\%$.
- Multi-gas meter (VOCs, methane, ammonia, hydrogen sulfide) precision will be $\pm 3\%$ and accuracy will be $\pm 5\%$.

To ensure sample representativeness, sample collection and preservation will be performed in accordance with the requirements set forth in the USEPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846, Third Edition with revisions), Methods for Chemical Analysis of Water and Wastes (MCAWW, EPA-600/4-79-020), "TO-15, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA/625/R-96/0101b" and the specific methods referenced in Section 7.0 of this QAPP, and recommendations made by the analytical laboratory.

The data quality objective for the completeness of data with respect to sampling (monitoring effort) is 100%. Although this goal appears rather ambitious, it can be attained. In the event 100% is not obtainable, the effect of the uncollected data will be evaluated by the Project QA Team to determine its impact (if any) on

project objectives. Audits of field activities (described in Section 10.0 of this QAPP) may also be performed to ensure compliance with sampling procedures. Corrective actions will be initiated to resolve data gaps from the original objectives which are found as a result of less than 100% data completeness. Every effort will be made to obtain valid data for all sampling points, particularly those considered to be critical points. In this regard, the identified critical point samples will necessarily be selected as subsequent QC samples (duplicate and matrix spikes) at the frequency specified in Section 9.0.

In order to establish a degree of comparability such that observations and conclusions can be directly compared with all historical data, standardized methods of laboratory and field analysis, sample collection, holding times, and preservation will be applied. In addition, field conditions will be considered in evaluating sampling results in order to attain a high degree of data comparability.

3.3

ANALYTICAL LABORATORY DATA QUALITY OBJECTIVES

The analytical laboratories will demonstrate analytical precision and accuracy by conducting the analysis of laboratory duplicates and matrix spike duplicates. Precision (as well as instrument stability) will also be demonstrated by the comparison of response factors for calibration standards. Laboratory accuracy will be demonstrated by the addition of surrogate and matrix spike compounds and will be presented as percent recovery (R). Precision will be presented as relative percent differences (RPD), relative standard deviation (RSD), or percent difference (PD), whichever is applicable to the type of QC samples involved. Laboratory method blanks will also demonstrate accuracy with respect to the analyses. The frequencies of laboratory duplicates, matrix spikes and laboratory blanks are specified in Section 9.0.

The analysis laboratory will process (purge, extract, or digest) an aliquot of sample such that the analytical results will provide a high degree of representation with respect to the sampling point. In addition, the analytical laboratory will document all analytical issues arising during the course of the monitoring effort. Communication will be maintained with the laboratory so that analytical issues encountered with critical sample points will allow those samples to be re-collected, if necessary. Further, the laboratory will provide all data packages in the CLP-equivalent data package deliverables format to ensure that analytical methods, parameters, and reporting units are compatible throughout the sampling effort.

CRITERIA OBJECTIVES

The quantitative objectives that will be required for both field and laboratory accuracy and precision are summarized in Table 3-2. The laboratory will (as an objective) report the laboratory RL for all samples in the appropriate statistical reporting units for all analyses. However, it should be noted that actual RLs are sample specific and depend on variables such as dilution factors, sample matrices, and the specific analyte. The data reported at or near the RL will be handled cautiously since the stated data quality objectives for accuracy and precision may not "translate" well in some situations (i.e., accuracy and precision suffer for results near the RL).

DATA MANAGEMENT OBJECTIVES

It is a data management objective that all aspects of the investigation from sample design, collection, shipment, analysis use/decisions, etc. be performed in conjunction with rigorous QA/QC documentation. The specific details of this documentation can be found throughout this document.

It is expected that by the design of separate data quality requirements for field sampling and laboratory analysis, clear distinctions can be made such that any issues identified in the system can be isolated with respect to the cause. Conversely, the data quality requirements are also designed to provide an indication of the variability inherent in the overall system.

Consistent with the ASAO, records and documentation applicable to the Site will be maintained for a minimum of seven years after commencement of construction of any remedial action at the Site. At the conclusion of the document retention period, the USEPA will be notified at least 90 days prior to the destruction of any documents, records or other information. Upon request, this information may be transferred to the USEPA for final disposition.

The overall data management objective is to provide a complete database with a high degree of confidence through the use of a phased approach for sampling, analysis, data assessment (data review), data qualification, and feedback.

4.0

SAMPLING METHOD REQUIREMENTS

A general discussion of the types of samples to be collected is provided in the FSP (Appendix A). However, as previously noted, the Management Area-Specific Work Plans will provide some detail on the sample locations, depths and analyses for each specific sample. This section describes the sampling methods and procedures that will be used to collect samples of air, liquids, and solids for the various activities associated with the SWWP.

4.1

DRILLING ACTIVITIES

Drilling activities will be conducted in support of geotechnical testing, existing landfill cover survey, monitoring well and piezometer installation, and soil sampling activities. Wherever possible, sampling locations will be collocated to minimize disturbance and duplication of field efforts. The following sections describe the majority of the intrusive activities conducted under the RI.

4.1.1

Soil Borings

Soil borings will be completed using three general methods: (1) standard hollow stem auger\drilling equipment and split-spoon sampling methods, (2) hand auger sampling and drilling, or (3) direct-push drilling and sampling methods as described in detail in Standard Operating Procedure (SOP) 6800, 6801, and 6802 (Appendix E) respectively. These boring techniques are detailed in the FSP.

Soil samples will be collected continuously from the ground surface to the final depth of each boring using either split-spoon, direct push drilling, or hand auger methods. Descriptions of the soil samples will be logged in the field, and observations recorded in a bound fieldbook. After completion of the soil boring program, a Drilling Log will be prepared following SOP 6805 (Appendix E) for each boring to document the physical characteristics of each soil sample and field observations made during drilling and sampling.

Soil samples will be screened in the field with an organic vapor analyzer (e.g., photoionization detector, or PID) using the procedure described in SOP 6803 (Appendix E).

At the time of sample collection, soil samples will be properly labeled and immediately placed in a cooler with ice or ice packs to maintain the proper temperature for shipping samples to the laboratory. Samples will be labeled and handled in accordance with the requirements described in Section 3.

Requirements for sample documentation and handling are also presented in Section 3.

Upon completion of each soil boring, the boring will be backfilled with soil cuttings as described in SOP 6804 (Appendix E).

4.1.2

Shallow Groundwater Wells

Some soil borings, at select locations, will be converted to shallow groundwater wells. The groundwater investigation consists of activities to assess site-wide groundwater quality and determine the direction of ground water flow across the Site. These activities include the installation of groundwater monitoring wells in upland areas with drilling rig access and piezometers that will be placed in soft-soil locations near streams or wetlands, water level monitoring, and the collection of ground water samples for chemical analysis.

The shallow overburden monitoring wells will be installed in accordance with the requirements of COMAR 26.04.04.07 and SOP 6806 (Appendix E). Wells will be installed to a depth of approximately 5 feet below the water table using either hollow stem auger, rotary, hand auger, or direct push drilling methods. After first water is encountered a well or piezometer will be installed if a minimum of 5 feet of water can be maintained in the well/piezometer after it is placed in the well (but not completed with sand, bentonite, and grout). Monitoring well construction is illustrated in SOP 6806 (Appendix E).

Drill cuttings will be collected from the entire depth of the borehole for each well for visual examination and field classification of soil types as described in SOP 6805 (Appendix E). Drill cuttings will be screened in the field with an organic vapor analyzer (e.g., photoionization detector, or PID) using the procedure described in SOP 6803 (Appendix E).

After well installation is completed, each monitoring well and piezometer will be developed to remove fine-grained sediments and to stabilize the filter pack. Wells will be developed using bailing, pumping, surging, and/or air lift methods as described in SOP 6807 (Appendix E).

Borehole cuttings generated during drilling and purge water generated during well development will be managed as investigation-derived wastes as described in SOP 6808 (Appendix E).

4.2

GEOTECHNICAL EVALUATION

The objective of the geotechnical investigation is to assess the vertical subsurface profile in potentially developable areas of the Site, and analyze the physical properties of fill materials and native soils present. Information obtained from the geotechnical investigation will assist in remedy formulation and evaluation,

and will also provide preliminary insight into potential reuse opportunities and/or constraints.

The geotechnical investigation will consist of soil borings and test pits. Soil samples collected from several of the borings will be utilized for analytical laboratory testing (Section 2.9.1) in addition to geotechnical testing.

Geotechnical borings will be installed using hollow-stem auger drilling methodology as described in SOP 6809 (Appendix E).

Upon completion of each soil boring, the boring will be backfilled with soil cuttings to within approximately one foot of existing grade as described in the SOP 6804 (Appendix E).

Following completion of each test pit, the material removed from the test pit will be used to backfill the excavation. The backfill material shall be placed in two (2) foot lifts and uniformly compacted with the backhoe bucket.

4.3

COVER SYSTEM THICKNESS EVALUATION

The objective of the cover system thickness evaluation is to identify the areas where cover soil has previously been installed above waste material and to assess the thickness of the cover soil. The results of the thickness assessment will be used to assist in remedy evaluation. Shallow borings will be installed throughout the Source Areas (and potential redevelopment areas) in order to determine if a cover soil is present above the artificial fill material and, if so, the thickness of the cover soil layer. The site will be overlaid with a 200-foot by 200-foot grid (Figure 3) to assist in determining where the shallow borings should be installed. In each of the Source Areas, one boring will be installed within each grid block; this corresponds to a frequency of roughly one boring per acre. In potential redevelopment areas not located within a Source area, one boring will be installed within every other grid block; this corresponds to a frequency of roughly one boring per two (2) acres. The shallow borings will be installed just into the underlying artificial fill material using hand auger or direct-push Geoprobe® methodology (SOP 6801, 6802 – Appendix E); the method used may vary depending on accessibility constraints, anticipated thickness of cover soil, etc.

Upon completion of each shallow boring, the boring will be backfilled with soil cuttings to the existing grade as described in SOP 6804 (Appendix E). If necessary, the remaining space will be backfilled to the ground surface with a cement/bentonite mixture.

4.4 *STREAM GAUGING*

4.4.1 *Monitoring Locations*

The monitoring locations for evaluating stream flow hydraulics and water quality will be described in the Management Area-Specific Work Plans. Each monitoring location will be surveyed for horizontal coordinates. The location of the sampling station will be identified and marked using a GPS receiver. The general location relative to permanent landmarks will be recorded in a logbook. At several locations within the primary drainages, the channel geometry will be determined as standard surveyed cross-sections using a tripod level and rod (or equivalent) as described in SOP 6810 (Appendix E).

4.4.2 *Stream Flow Measurements*

Discharge measurements will be made at each of the designated monitoring locations along the primary drainages (e.g., Herring Run) according to the schedule to be outlined in the Management Area-Specific Work Plans. Stream discharge will be measured and calculated based on the SOP 6811 (Appendix E).

4.5 *MULTIMEDIA SAMPLING*

4.5.1 *Soils*

To ensure that sufficient analytical data is available for the human health risk assessments, supplemental soil samples will be required. Soil samples will be collected from the soil borings as described in Section 2.5.1 of the FSP. Analysis and handling of the samples is described below. The location of the sampling station will be identified and marked using a GPS receiver. The general location relative to permanent landmarks will be recorded in a logbook.

4.5.1.1 *Field Screening*

Each soil sample collected above the water table will be screened in the field with an organic vapor analyzer (i.e., photoionization detector, or PID) at the time of sample collection utilizing a headspace method as described in SOP 6803 (Appendix E).

4.5.1.2 *Surface Soil*

As noted previously, for the purpose of this RI, surface soil is defined as soil less than 2 feet below surface grade. Surface soils will be collected following SOP 6812 (Appendix E).

4.5.1.3 *Subsurface Soil*

The same precautions for sampling of surface soils apply to subsurface soils (i.e., defined as soils below a depth of 2 feet for the purpose of this project).

The Management Area-Specific Work Plans will address the locations and depths from which the samples will be obtained. Subsurface samples will be obtained by two methods: shallow subsurface sampling by hand-operated equipment and deep subsurface samples by use of a drilling rig (i.e., hollow-stem auger or Geoprobe) or a backhoe following SOPs 6800, and 6802 (Appendix E).

4.5.2 *Surface Water*

Prior to sampling, the surface water drainage in and around the Site will be reviewed using all available background information, including topographic maps and aerial photographs. An initial field survey of the Site will be conducted to identify sampling locations. This site survey will help to identify any special equipment, personnel safety requirements, or procedures that might be necessary due to terrain or other factors specific to the site. Also, stream characteristics, such as stagnation zones or mixing zones that might affect the distribution or volatilization of constituents in the water, will be noted and recorded in the field log book. Surface water samples will be collected following SOP 6813 (Appendix E).

4.5.3 *Groundwater*

Ground water samples will be obtained from two types of wells; monitoring wells or temporary piezometers. The sampling is further divided into three subsections: (1) water level sampling, (2) well evacuation, and (3) sample collection.

4.5.3.1 *Water Level Sampling*

The majority of the wells used in this RIFS will have inside diameters of less than two inches. There are some existing onsite wells that may have larger diameters. Prior to well evacuation or sampling the water level in all wells will be measured using SOP 6814 (Appendix E).

4.5.3.2 *Well Evacuation*

Wells and piezometers will be evacuated following the SOP 6815 (Appendix E).

4.5.3.3 *Sample Acquisition*

The procedure for sample acquisition is outlined in SOP 6816 (Appendix E).

4.5.4

Leachate Seeps

Field personnel will collect a sample of overburden groundwater that seeps onto the ground surface, should seeps be identified during the RI field activities following SOP 6817 (Appendix E). Seep samples will be analyzed for parameters as shown in Table 4-1. If possible, after sample collection the pH, temperature, and conductivity of the seep water will be measured and recorded using an YSI 600XL (or equivalent) meter. The location of the sampling station will be identified and marked using a GPS receiver. The general location relative to permanent landmarks will be recorded in a logbook.

4.5.5

Sediment

The primary aquatic environments; i.e., Herring Run, Moores Run, and Redhouse Run, will be evaluated during the RI. Sediment sampling within these streams, and at select upstream and downstream locations, will discern whether there are Site-related exposures contributing to ecological risks. Because the streams are part of a larger urban watershed, information will be required relative to upstream conditions for each stream. Actual sampling locations will be selected based on physical depositional characteristics (i.e., particle-size distribution in the sediment), and these will be presented and discussed in the Management Area-Specific Work Plans.

The sediment sampling protocol is described in SOP 6818 (Appendix E). Prior to sampling at a location, the sediment grabs, cores and all other sampling devices, such as spoons, will be decontaminated in accordance with procedures set forth in SOP 6819 (Appendix E).

4.5.6

Soil-Gas

The installation of soil-gas monitoring points will consist of a Geoprobe boreholes placed into the subsurface vadose zone a maximum depth of 5 feet that can be monitored thereafter through tubing extending to the ground surface. The surface of the installation would be sealed with bentonite and grout, and covered for protection. The intent is that these monitoring points will read the concentrations of gas accumulating in the soil voids. The implants will remain in the ground to permit subsequent sampling on a periodic basis throughout the RI. The points will be marked in the field and the location as read from the GPS will be recorded in the fieldbook. An example of the soil-gas implant procedure is included in SOP 6820 (Appendix E).

After installation, a small amount of soil vapor will be purged from the probe to adequately flush the sample probe and line. The subsurface vapor points will then be capped to ensure no moisture enters the tubing, and allowed to equilibrate at least overnight prior to sampling.

Each sampling point will be analyzed in the field for temperature, pressure, LEL percentage, hydrogen sulfide, ammonia, VOCs, and oxygen using a BW Technology GasAlertMicro 5 PID following SOP 6821 (Appendix E). In addition, samples will be obtained using Summa canisters for laboratory analysis of the gaseous constituents as described in SOP 6822 (Appendix E). A full scan (TO-15ⁱ) of volatile constituents will be evaluated in the laboratory in addition to the replication of the field parameters. The laboratory will report results in ug/m³.

4.5.7 *Biological*

Biological sampling and analysis includes a reconnaissance survey and follow-up sampling event that is comprised of fish collection, a qualitative benthic survey, and the collection of samples for sediment toxicity testing. The collection of samples for sediment toxicity testing will be coordinated with the sediment sampling survey.

4.5.7.1 *Reconnaissance Survey*

A reconnaissance survey will be used to refine the fish sampling program. This survey will be most useful if Federal and/or State agency personnel can participate inasmuch as it will be used to establish conditions and finalize sample locations. The field observations will be used to finalize sampling methodology and the number of biota samples that can be realistically collected in a main sampling event. The objectives, procedures, and justification for the reconnaissance survey activities are described in SOP 6823 (Appendix E).

4.5.7.2 *Fish Collection*

Fish will be collected to meet two objectives: 1) identification of predominant species; and 2) evaluation of levels of bioaccumulative compounds in tissues. Sampling is anticipated to occur in three areas: Herring Run upstream of the I-95 bridge (Upstream), Herring Run from the I-95 bridge to the Amtrak Railroad bridge (including Moores Run) (Site), and from the Amtrak Railroad Bridge to the I-695 bridge (Downstream). The fish will be collected following SOP 6824 (Appendix E).

4.5.7.3 *Collection of Benthic Community Samples*

Benthic community samples will be taken at the sediment sampling locations for the Site for qualitative analysis. These collections are not used to compare areas

ⁱ This method was prepared for publication in the *Compendium of Methods for the determination of Toxic Organic Compounds in Ambient Air, Second Edition* (EPA/625/R-96/010b).

with respect to potential impacts, as this would be difficult given the heterogeneity of this particular environment. Rather, these samples are used to understand the types of benthic receptors present throughout the area. These qualitative samples will be taken at selected sampling stations in the runs above, within, and below the 68th Street site. Because, these samples are taken for qualitative purposes only, one sample will be obtained at each location for identification of taxa. Two possible sampling methods will be employed depending on habitat. Grab samples will be used where sediments are comprised of silts and sands. Surber samples will be used where sediments are comprised of gravel, rocks, and debris. Both methods are outlined in SOP 6825 (Appendix E) for sediment collection.

Habitat conditions at each of the sample locations will be evaluated in the field and by several of the analytical measurements made in the laboratory. At each fish collection and benthic community station, the following will be determined: physical characteristics of sediments (i.e., field observations and grain size analysis), organic content of sediments (i.e., field observations on the nature of the sediments and laboratory measurements of total organic carbon), water depth, stream flow velocity (as estimated or measured in the field), width of water body, characteristics of shoreline, bordering vegetation, extent of overhanging vegetation. Observations for the Habitat Assessment will be guided by the *Habitat Assessment Field Data Sheet-Low gradient Streams, USEPA Rapid Bioassessment Protocols*, 1989.

4.6

SAMPLE PREPARATION AND PRESERVATION

Preservation methods will be limited to pH control, chemical addition, refrigeration, and freezing. Table 4-1 displays the recommended volume sizes, container types, preservatives, and holding times for the selected analytical methods. The sample bottles supplied by the laboratory will be preserved before being used in the field and bottles will be placed in a cooler with ice as soon as possible after sampling.

5.0

SAMPLE CUSTODY

The primary objective of sample custody procedures is to create an accurate written record which can be used to trace the possession and handling of all samples from the moment of their collection, through analysis, until their final disposition. Custody for samples collected during this investigation program will be maintained by the Field Task Manager or designated field personnel collecting the samples. The Field Task Manager, or the field personnel, will be responsible for documenting each sample transfer and maintaining custody of all samples until they are submitted to the laboratory.

Sample containers will be obtained from Environmental Sampling Supply (ESS) as PC class or equivalent bottles for soil, water, and tissue samples, with the exception of soil samples for VOC analysis, which will be 5 gram EnCore sample containers. All necessary chemical preservatives will be added to the bottles by the laboratory prior to the sampling event, where appropriate. Custody of the sample bottles will be maintained by the Field Task Manager, or designee. Sample bottles required for a specific sampling task will then be relinquished by the Field Task Manager to the sampling team after the Field Task Manager has verified the integrity of the bottles and ensured that the proper bottles have been assigned to the appropriate task.

The air samples for Method TO-15 analysis will be collected in six-liter stainless steel Summa canisters with a passivated interior surface. The canisters will be cleaned and certified by the analytical laboratory before delivery to the field.

5.1

PACKAGING AND SHIPPING PROCEDURES

Once the samples have been collected, prepared, preserved, and appropriately stored, they must be packaged for shipment and/or delivery to the designated laboratory. In addition, from the time of sample collection until the analyses have been completed, chain-of-custody procedures must be followed to ensure the proper handling and possession of the samples SOP 6826 (Appendix E). SOP 6827 (Appendix E) outlines procedures for the packing and shipping of environmental samples.

5.2

CHAIN OF CUSTODY

The chain-of-possession and custody of any samples that form the basis of analytical test results introduced, as evidence needs to be maintained. Written procedures must be available and followed whenever samples are collected,

transferred, stored, analyzed, or destroyed. The primary objective of these procedures is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and its introduction as evidence. The SOP for field chain of custody procedures will be followed at all times (SOP 6826 – Appendix E).

Once the samples have been received at the laboratory, the Laboratory Sample Custodian will note any damaged sample containers or discrepancies between the sample label and information on the field Chain-of-Custody record when logging the sample, and will note any discrepancies. This information will also be communicated to the Field Task Manager to permit proper actions to be taken.

The Laboratory Sample Custodian will note any damaged sample containers or discrepancies between the sample label and information on the field Chain-of-Custody record. This information will be communicated to the Field Task Manager or field personnel to permit proper actions to be taken. The Chain-of-Custody form will be signed by both the relinquishing and receiving parties each time the sample changes possession, and the reason for transfer indicated.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

6.1 LABORATORY CALIBRATION

Sample analyses will be conducted in accordance with the following standard protocols:

- "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846, Third Edition with revisions);
- "Methods for Chemical Analysis of Water and Wastes" (MCAWW, EPA-600/4-79-020);
- "TO-15, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air" (EPA/625/R-96/0101b); and ,
- Other specific methods referenced in Section 7.0 of this QAPP.

Laboratory calibration and frequency is specified in the referenced methods and summarized in the Laboratory Quality Manuals provided in Attachment A.

6.2 FIELD CALIBRATION

In addition to the laboratory analyses conducted during the course of this investigation effort, field measurements of pH, specific conductance, dissolved oxygen (DO), salinity, and temperature will be obtained for the groundwater, surface water and seep samples. Measurements of subsurface gases (VOCs, methane, ammonia, hydrogen sulfide) will be measured using a multi-gas meter. As detailed in Section 7.2 of the FSP, field personnel will be responsible for the calibration of field equipment, with the calibration information recorded directly in the field notebook. Field equipment will be calibrated using standard solutions with certified concentrations and performed according to the manufacturer recommendations.

ANALYTICAL PROCEDURES

All analytical procedures will be approved USEPA procedures, protocols or guidance. The appropriate methods, the primary compound list, and the respective reporting limits are presented in Tables 7-1 through 7-11. The required holding times are presented in Table 4-1. Standard laboratory turnaround for sample analysis will be required. Analytical procedures will be performed according to:

- "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846, Third Edition with revisions);
- "Methods for Chemical Analysis of Water and Wastes" (MCAWW, EPA-600/4-79-020);
- "TO-15, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air" (EPA/625/R-96/0101b); and,
- Other specific methods referenced in Tables 7-1 through 7-11.

The primary compound list will include volatile organics, semi-volatile organics, pesticides/PCBs, herbicides, dioxin/furans and metals. Other miscellaneous analyses will also be conducted (i.e., total phenolics, cyanide, etc.), as indicated in Table 7-11.

DATA REPORTING, VALIDATION, AND REDUCTION

Data validation practices will be followed to ensure that raw data are not altered and that an audit trail is developed for those data which require reduction. All field data, such as those generated from field measurements, observations, and sampling, will be entered directly into a bound field notebook. Each field team member will be responsible for validating all of the data transfers made, and the Field Task Manager will independently validate at least ten percent of all data transfers.

Upon receipt of the sample data packages, the Laboratory Quality Assurance Chemist will qualitatively and quantitatively review the data packages prior to shipment to the Site QA Manager. Thereafter, an independent validation of the data will be performed, as specified in Section 12.0.

It is anticipated that data reduction will be minimal and will consist primarily of tabulating the laboratory analytical results in summary tables through the use of computerized spreadsheet software. All analytical data will be provided in the form of an electronic data deliverable which will be loaded into an electronic database. All reduced data will be assigned document control identification numbers and placed in the central file maintained by the Field Task Manager.

Analytical data for soil/solid matrices will be corrected for moisture content, and reported as micrograms per kilogram ($\mu\text{g}/\text{kg}$) for organic parameters and milligrams per kilogram (mg/kg) for inorganic parameters. Analytical data for aqueous matrices will be reported as micrograms per liter ($\mu\text{g}/\text{L}$) for all parameters and analytical data for air samples will be reported in units of micrograms per cubic meters ($\mu\text{g}/\text{m}^3$).

All raw field data will be summarized, reduced, or tabulated for use by the Field Task Manager. All laboratory analytical data will be summarized and tabulated upon receipt, validated and qualified (see Section 12.0), and the final data submitted to the project team for use in the production of the RI/FS reports. Specific data analysis requirements will be described in the Management Area-Specific Work Plans.

The project will require a rigorous data control program that will ensure that all documents for the investigation are accounted for as they are completed. Accountable documents include items such as logbooks, field data records, correspondence, chain-of-custody records, analytical reports, data packages,

photographs, computer disks, and reports. The Project Manager is responsible for maintaining a central file in which all accountable documents will be inventoried.

Table 8-1. Required Deliverables for CLP-Equivalent Data Deliverables Format

	Description
Title Page	Present site name, field sample numbers and corresponding laboratory control numbers and the appropriate laboratory manager's signature authorizing release of the data.
Case Narrative	Summarize any problems encountered during analysis and discuss any corrective actions taken.
Table of Contents	List all major sections of the delivered document with the referenced page numbers. This can be incorporated onto the Title Page.
Chain of Custody Forms and Internal Chain of Custody	Copies of the documents signed by the laboratory sample log-in personnel.
Laboratory Chronicle	Supply the dates of preparation and analysis for each analyzed fraction and sample.
Methodology Summary and Method References	Present a brief summary of the method used and the appropriate method reference.
Sample Data	Analytical reports presenting the compounds/analytes, the concentrations for positive hits, and the reporting limits for all compounds/analytes that were not detected. Individual analysis reports are provided for each sample.
Quality Control Summaries	Summary forms for surrogate recoveries, internal standards (response and retention times), matrix spike/matrix spike duplicate summaries (recoveries, RPDs, and QC limits), serial dilution results, interference check standard results, laboratory duplicates, instrument and method blank results, laboratory control sample recoveries and QC limits, GC/MS tuning summaries, and initial and continuing calibration summary forms.
Raw Sample Data	Provide GC chromatograms and instrument quantitation reports that include a library list of compounds, peak retention times, peak areas, peak heights and raw concentration data.
Raw Quality Control Data	Provide GC chromatograms and instrument quantitative reports including a library list of compounds, peak retention times, peak areas, peak heights and raw concentration data for each method blank and the matrix spikes and matrix spike duplicates.
Miscellaneous Quality Control Data	Run logs presenting the chronology of sample and standard analysis along with sample extraction or preparation logs.

To maintain control in the transfer of data, all copies of raw data from the field notebooks, as well as the data received from the laboratory, will be entered into a

data file and assigned an appropriate document control identification number. The data file will serve as the ultimate archive for all information and data generated during this investigation effort.

The documentation of sample collection will include the use of bound field fieldbooks in which information on sample collection and field instrument calibration will be entered in indelible ink. Appropriate information will be entered to reconstruct the sampling event, including the site name, sample identification, brief description of sample, date and time of collection, sampling methodology, field measurements and observations, and sampler/operator name and date. Procedures for the Field Notebook (SOP 6828) are presented in Appendix E.

9.0

INTERNAL QUALITY CONTROL CHECKS

Internal quality control checks for the analytical laboratory and the field are presented below. The Data Quality Objective criteria for these internal quality control checks are presented in Table 3-2.

9.1

LABORATORY INTERNAL QUALITY CONTROL CHECKS

Laboratory Internal Quality Control Checks will be utilized during this investigation through the use of the following:

- Surrogates: Appropriate surrogate compounds will be utilized for all analysis of organic compounds. Surrogate recoveries will be evaluated according to the limits provided in the method, or laboratory-generated limits. The laboratory will initiate corrective action for the analysis if the surrogate recoveries fall outside of these limits.
- Laboratory Control Samples: A Laboratory Control Sample (LCS) will be used in accordance with the guidelines for the specific method. The recoveries for the LCS sample will be evaluated with respect to method control limits or laboratory-generated control limits. The laboratory will initiate corrective action for the analysis if the LCS recoveries fall outside of the laboratory limits.
- Laboratory Method Blanks: Laboratory method blanks will be prepared and analyzed with each batch of samples. If target compounds are detected in the method blanks at concentrations equal to or greater than the Detection Limits required by the methods, corrective action will be initiated by the laboratory.
- Calibration Standards: Initial and continuing calibration standards will be analyzed and evaluated according to the guidelines provided in the analytical methods. The laboratory will initiate corrective action for the analysis if the calibration standards do not meet the listed criteria.

9.2

FIELD INTERNAL QUALITY CONTROL CHECKS

Field Internal Quality Control Checks will be utilized during this investigation through the application of the following:

- Trip Blanks: Consists of analytically pure water or solid in containers identical to those used for samples. The empty sample containers are filled prior to sampling, carried with the collected samples, and returned to the laboratory for analysis. These samples should be submitted to the

laboratory using a fictitious sample location so they are 'blind' to the laboratory. Trip blanks should be analyzed exactly as are the environmental samples submitted on a day when VOC samples are collected. Trip blanks be submitted one per sample day to serve as an indicator of container cleanliness, external contamination, and contamination from analytical procedures.

- Equipment Rinsate Blank: Equipment rinsate blanks will be collected to ensure that the sampling equipment is clean and that the potential for cross contamination has been minimized by the equipment decontamination procedures. These blanks will be collected by decontaminating the sampling device and then pouring ultra-pure deionized water over the device. This rinsate water will be collected into a clean stainless steel bowl and then transferred to the appropriate sample containers. One equipment rinsate blank will be collected for each sampling device associated with the soil, groundwater, surface water/seep and sediment samples. A solid sampling equipment rinsate blank will be collected for split-spoon samplers, hand augers, spoons, etc. The equipment rinsate blanks will be analyzed for identical parameters as the associated samples. Equipment rinsate blanks will be collected from each sampling device, at a frequency of one per 20 samples or one per sampling event, whichever is more frequent.
- Field Blank: Field blanks will be collected to ensure that sample containers are clean. These blanks will be collected by pouring ultra-pure deionized water into the sample container in the field. Field blanks will be collected for each medium sampling event at a frequency of one per 20 samples or one per sampling event, whichever is more frequent. The field blanks will be analyzed for identical parameters as the associated samples.
- Matrix Spike Sample: Matrix spike/matrix spike duplicate (MS/MSD) samples will also be submitted as further quality control (QC) checks. These samples will be spiked by the laboratory, and will be collected at the frequency of one MS and MSD for every 20 field samples. These samples will allow accuracy to be determined by the recovery rates of compounds (the matrix spike and/or surrogate spike compounds defined in the analytical methods). Precision will also be assessed by a comparison of matrix spike and matrix spike duplicate recoveries. The purpose of the laboratory spikes is to monitor any possible matrix effects specific to samples collected from the Site. The addition of known concentrations of compounds/constituents into the sample also monitors extraction/digestion efficiency.

- Field Duplicate Samples: Field duplicate samples will be collected to allow the determination of analytical and sampling precision. One field duplicate sample will be collected for every 20 soil, sediment, groundwater, and surface water/seep samples and submitted for the identical parameters as the associated sample.

10.0 PERFORMANCE AND SYSTEMS AUDITS

10.1 ON-SITE AUDIT

One on-site systems field audit may be performed during the initial system start-up to review all field-related quality assurance activities. The Quality Assurance Manager would conduct any system audit. Figure 10-1 presents the Quality Assurance Audit forms to be utilized in this application. The acceptance criteria for the field audit would be adherence to the protocols presented throughout this QAPP. Deficiencies identified during the audits would be brought to the attention of the responsible individuals and corrective actions, in accordance with Section 13.0 of this document, would be initiated. Copies of the audits would be distributed to all key project personnel.

Specific elements of the on-site audit include the verification of the following:

- Completeness and accuracy of sample Chain-of-Custody forms, including documentation of times, dates, transaction descriptions, and signatures.
- Completeness and accuracy of sample identification labels, including notation of time, date, location, type of sample, individual collecting sample, preservation method used, and type of testing required.
- Completeness and accuracy of field notebooks, including documentation of times, dates, names, sampling methods, sampling locations, number of samples collected, sampling team, types of samples, results of field measurements, and any problems encountered during sampling.
- Adherence to health and safety guidelines outlined in the Site Health and Safety Plan, including the wearing of proper protective clothing.
- Adherence to decontamination procedures.
- Adherence to sample collection, preparation and storage procedures.

10.2 LABORATORY AUDIT

10.2.1 Internal Laboratory Audits

The individual analytical and geotechnical laboratories will have performed regular systems and performance audits as required by the Laboratory Quality Manuals.

10.2.2

Laboratory Performance Audit

The QA Manager, or designee may perform an on-site audit during the course of the investigations to ensure adherence to the QAPP. The results of the laboratory audits will be submitted to the Project Coordinator for review and incorporation into the following Monthly Progress Report. If the results of the audit necessitate further action, the Project Manager will be notified of such and will be apprised of any corrective action taken.

Figure 10-1. Quality Assurance Audit Form

Project: _____ WO Number: _____

Date: _____

Auditor(s): _____

On-Site Sampling Personnel: _____

Audit Conducted on the following:

____ Composite Sampling ____ Decontamination

____ Grab Sampling

Y = Yes

N = No

N/A = Not Applicable

N/D = Not Determined

Sample Collection:

Do sampling locations agree with those specified in the Work Plan/Sampling Plan? _____

Is the sampling location both documented sufficiently and marked to allow it to be located again in the future? _____

Are sampling times, ERM Traffic Report Numbers and sample description noted in the FNB? _____

Is sampling proceeding from the suspected least contaminated area to the most contaminated area? _____

Have all field measurements been properly taken as per Sampling Plan? _____

Are field measurement(s) being taken immediately after the sample is collected? _____

Have sample bottles been labeled properly? _____

Have proper containers and preservatives been used? _____

Are proper sample volumes procured? _____

Does the potential for sample cross-contamination exist based on procedures observed? _____

Have MS and MSD(s) been collected as per QA/QC Plan? _____

Does a travel blank exist for each matrix present? _____

Are samples being refrigerated/iced immediately after collection? _____

Has condition of sample been recorded in the FNB and in the traffic report? _____

Figure 10-1. Continued

Have legal seal(s) been properly filled out and attached to the shipping container(s)? _____

Decontamination:

Has sampling equipment been decontaminated properly for the given analyses as per QA Plan? _____

Have the proper decontamination solutions been used? _____

For large equipment (backhoes, drill rigs), has decontamination taken place in an appropriate area? _____

Has decontamination water/solution been collected for proper disposal? _____

Where disposed? _____

Has disposable equipment, that is contaminated, been properly deconned and disposed of? _____

Have decon samples been taken from the sampling equipment as per Sampling Plan? _____

Has all appropriate information been recorded in the FNB? _____

Have the weather conditions been recorded? _____

Are weather conditions affecting sample quality? _____

Is the "Chain of Custody" being maintained for the samples? _____

Have all personnel been properly trained to operate the equipment present? _____

Are the objectives of the sampling activities understood by the field personnel? _____

Are employees conducting the investigation in a professional manner? _____

Audit Summary and Comments:

Figure 10-1. Continued

Signed by:

Sampler: _____ Print Name: _____

Auditor: _____

Date: _____

11.0 PREVENTIVE MAINTENANCE

11.1 LABORATORY MAINTENANCE

The individual analytical and geotechnical laboratories preventive maintenance programs and requirements are described in their respective internal Laboratory Quality Manual.

11.2 FIELD MAINTENANCE

Field equipment will be maintained by the equipment rental contractor under contract, and will be maintained according to the equipment specifications and the rental contractor preventative maintenance programs and requirements. Routine daily maintenance procedures conducted in the field will include the following:

- Removal of surface soil and debris from exposed surfaces of the sampling equipment and measurement systems;
- Cleansing of filters on the organic vapor analyzer;
- Storage of equipment away from the weather elements;
- Daily inspection of sampling equipment and measurement systems for possible issues (e.g., cracked or clogged lines, or tubing, weak batteries, etc.);
- Completing the appropriate instrument calibrations; and,
- Charging any battery packs for equipment when not in use.

Spare and replacement parts for the equipment will be stored in the field to minimize downtime during replacement; these will include the following:

- Appropriately sized batteries;
- Locks;
- Extra sample containers and preservatives;
- Multi-gas meter igniters and filters;
- Multi-gas meter H₂ gas, battery charger, and support equipment;

- Extra sample coolers, packing material, and sample location stakes;
- Additional health and safety equipment; e.g., respirator cartridges, boots, gloves, tyvek, etc.; and,
- Additional equipment as necessary for the field tasks.

12.0 ROUTINE ASSESSMENT PROCEDURES

12.1 OVERALL PROJECT ASSESSMENT

Overall data quality will be assessed by understanding the DQOs, which have been established in the SWPMP and this SWWP. By maintaining documentation on decisions made during each phase of sampling, performing field and laboratory audits, reviewing (validating) the analytical data as it is generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, data accuracy, precision, and completeness will be closely monitored.

12.2 FIELD QUALITY ASSESSMENT

To ensure that all field data are collected accurately and correctly, specific instructions will be issued to all personnel involved in field data acquisition by the Field Task Manager. A field audit will be performed by the Field Task Manager during the initial sampling event of the investigation to document that the appropriate procedures are being followed for sample and QA/QC collection. These audits will include a review of the field books used by field personnel to ensure that the tasks were performed as specified in the instructions. The field audits will necessarily enable the data quality to be assessed with regard to the field operations.

The evaluation (data review) of trip and field blanks and other field QC samples will provide definitive indications of data quality. If an issue arises that can be isolated, corrective actions can be instituted for follow-on field efforts.

12.3 LABORATORY DATA QUALITY ASSESSMENT

Specific measures by the laboratories to assess data quality are presented in the individual Laboratory Quality Manuals provided in Attachment A.

12.4 LABORATORY DATA ASSESSMENT

12.4.1 Data Validation

The analytical data generated during the investigation will undergo a rigorous data validation review. CLP-equivalent data package deliverables will be

obtained from the laboratory. Consistent with USEPA-Region III guidance and the intended use of the Site data, organic data review level will be M2 and the inorganic review level will be IM-1. These reviews will be performed in accordance with the USEPA-Region III "Modifications to the National Functional Guidelines for Data Review" (Organic, 1994; Inorganic, 1993) and "Innovative Approaches to Data Validation" (USEPA 1995).

A detailed quality assurance review will be performed by the Quality Assurance Chemist to verify the qualitative and quantitative reliability of the data as it is presented. This review will include a comprehensive review and interpretation of data generated by the laboratories. The primary tools used will be guidance documents, established (contractual) criteria, and professional judgment. Table 12-1 presents the items to be examined during the quality assurance review.

Based upon the review of the analytical data, a quality assurance report will be prepared which will state in a technical, yet "user friendly" fashion the qualitative and quantitative reliability of the analytical data. The report will consist of a general introduction section, followed by qualifying statements that should be considered for the analytical results to best be utilized. Based upon the quality assurance review, qualifier codes will be placed next to specific sample results on the sample data tables. These qualifier codes will serve as an indication of the qualitative and quantitative reliability of the data. During the course of the data review, an organic and inorganic support documentation package will be prepared which will provide the backup information that will accompany all qualifying statements presented in the quality assurance review.

Once the review has been completed, the QA Manager will verify the accuracy of the review and submit these data to the Project Manager for use in developing the RI. The complete Quality Assurance Report will be signed and dated by the QA Manager.

Table 12-1. Items Reviewed During Data Validation

Area Examined	Applicability (organic, inorganic, both)
Chain of Custodies (Chain of Custody forms, Field Notes, etc.)	Both
Holding Times	Both
Extraction/Digestion Logs	Both
Blanks - field and laboratory (accuracy)	Both
Instrument Tune	Organic
Standards	Both
Linearity	Both
Sensitivity/Stability	Both
Variability of Technique (internal standards)	Organic
Analytical Run Log	Inorganic
ICP Interference	Inorganic
Control Standards	Both
Samples	
Detection Limits	Both
Instrument Printouts	
GG/MS data	Organic
Quantitative Reliability	Both
Calculations/Equations	Both
Matrix spikes	Both
Accuracy	
Bias	
Matrix spike duplicates	Organic
Bias	
Accuracy & Precision	
Surrogate Spikes	Organic
Bias	
Duplicates (field and laboratory)	Both
Precision	
Representativeness	
Post-Digestion Spikes	Inorganic
Matrix Effects	

As the analytical data generated during the investigation are validated, qualified, and submitted to the Project Manager for use, the quality of the data will be assessed from an overall management perspective by direct comparison to analytical results obtained from previous samplings. Information that can be obtained includes a comparison of results obtained from samples obtained within the same general vicinity and the identification of missing data points. By examination of the data at the "back-end" of the process, the data quality can be assessed with respect to representativeness, precision, compatibility, and completeness.

13.0 ***CORRECTIVE ACTION***

13.1 ***LABORATORY CORRECTIVE ACTION***

The analytical and geotechnical laboratories will provide documentation as to what, if any, corrective actions were initiated concerning their specific efforts and report them immediately to the QA Manager.

13.2 ***CORRECTIVE ACTION***

Field quality assurance activities will be reported topically to the Field Task Manager. Issues affecting overall quality assurance encountered during the investigations will also be reported to the Project Manager. The Project Manager will be responsible for initiating corrective actions, ensuring that the actions are instituted in a timely manner, and ascertaining that the desired results are produced. The Field Task Manager will report to the QA/QC Manager and Project Manager on all necessary corrective actions instituted, the outcome of these actions, and their effect on the data produced. Corrective actions will also be reported to the Project Coordinator and reported to the USEPA in the Monthly Progress Report.

QUALITY ASSURANCE REPORT TO MANAGEMENT

After project initiation, the Project Manager, in conjunction with the Field Task Manager and Quality Assurance Manager, will submit verbal and written progress report summaries of all applicable quality assurance activities to the Project Coordinator. Verbal reports will be provided on a weekly basis to the Project Manager, with a final written report submitted at the completion of the sampling and analysis activities. These summaries will contain at least the following types of information:

- The status and coverage of various laboratory and field quality assurance project activities;
- Data quality assurance reviews conducted, including assessment of accuracy, precision, completeness, representativeness, and comparability;
- Significant quality assurance issues discovered, corrective actions initiated, progress and improvements, plans, and recommendations for further implementation of updates to the QAPP. USEPA will be notified of any significant QA issues;
- Any significant field observations noted in the field notebook during the sampling procedure; and,
- Results of performance and system audit reports.

REFERENCES

COMAR 26.04.04.07

United States Environmental Protection Agency (USEPA), *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition*, EPA/625/R-96/0101b, January 1999.

United States Environmental Protection Agency (USEPA) Region III, *Innovative Approaches to Data Validation*, 1995.

United States Environmental Protection Agency (USEPA), *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, 1983.

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United States Environmental Protection Agency (USEPA), *Region III Modifications to the National Functional Guidelines for Data Review for Organic Compounds* (Organic, 1994 and Inorganic, 1993).

United States Environmental Protection Agency (USEPA), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846, Third Edition with revisions), 2004.

United States Environmental Protection Agency (USEPA), *Habitat Assessment Field Data Sheet-Low Gradient Streams, USEPA Rapid Bioassessment Protocols*, 1989.

Tables

Section 4.0 - Sampling Method Requirements
Table 4-1. Sample Analysis Summary

Matrix	Analyses	Method	Bottle Ware	Preservation	Holding Times	Laboratory
<u>Water</u>	VOCs	8260B	GL - 40 (3) mL vial	HCL, Cool 4°C	14 days	STL-Pittsburgh
Ground Water,	SVOCs	8270C	GL - 1L	Cool 4°C	7 days	STL-Pittsburgh
Surface Water,	Pesticides/PCBs	8081A / 8082	GL - 1L	Cool 4°C	7 days	STL-Pittsburgh
Leachate Seeps	Herbicides	8151A	GL - 1L	Cool 4°C	7 days	STL-Pittsburgh
	Dioxins/Furans	8290	GL - 1L	Cool 4°C	Extraction within 30 days, analysis within 45 days	STL-Knoxville
	Metals + mercury	6010B / 7470A	PL - 250mL	HNO3, Cool 4°C	6 months	STL-Pittsburgh
	Hexavalent chromium	7196A	PL - 250mL	HNO3, Cool 4°C	24 hours	STL-Pittsburgh
	Total cyanide	9012A	PL or GL -1L	NaOH, Cool 4°C	14 days	STL-Pittsburgh
	Total phenolics	9066	GL -1L	H2SO4, Cool 4°C	28 days	STL-Pittsburgh
	Total phosphorus	365.1	PL or GL / 100ml	H2SO4, Cool 4°C	48 hours	STL-North Canton
	Nitrate/Nitrite	353.2	PL or GL / 100ml	Cool 4°C	28 days	STL-Pittsburgh
	Ammonia Nitrogen	350.1	PL or GL / 250ml	H2SO4, Cool 4°C	28 days	STL-Pittsburgh
	Total Alkalinity	310.1	PL or GL / 100ml	Cool 4°C	14 days	STL-Pittsburgh
<u>Soil</u>	VOCs	8260B	5 gm Encore Sampler (set of 3)	Cool 4°C	48 hours	STL-Pittsburgh
Soil	SVOCs	8270C	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Pesticides/PCBs	8081A / 8082	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Herbicides	8151A	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Dioxins/Furans	8290	GL 4oz. wide mouth	Cool 4°C	Extraction within 30 days, analysis within 45 days	STL-Knoxville
	Metals + mercury	6010B / 7470A	GL 4oz. wide mouth	Cool 4°C	6 months-28 days	STL-Pittsburgh
	Hexavalent chromium	7196A	GL 4oz. wide mouth	Cool 4°C	24 hours	STL-Pittsburgh
	Total cyanide	9012A	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Total phenolics	9066	GL 4oz. wide mouth	Cool 4°C	28 days	STL-Pittsburgh
	Percent moisture	160.3	GL 4oz. wide mouth	--	--	STL-Pittsburgh
<u>Sediment</u>	VOCs	8260B	GL 4oz. wide mouth	Cool 4°C	48 hours	STL-Pittsburgh
Sediment	SVOCs	8270C	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Pesticides/PCBs	8081A / 8082	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Herbicides	8151A	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Dioxins/Furans	8290	GL 4oz. wide mouth	Cool 4°C	Extraction within 30 days, analysis within 45 days	STL-Pittsburgh
	PCB homologs / Congeners	Modified 8270 / 8082	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Metals + mercury	6010B / 7470A	GL 4oz. wide mouth	Cool 4°C	6 months-28 days	STL-Pittsburgh
	Hexavalent chromium	7196A	GL 4oz. wide mouth	Cool 4°C		STL-Pittsburgh
	Total cyanide	9012A	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	Total phenolics	9066	GL 4oz. wide mouth	Cool 4°C	28 days	STL-Pittsburgh
	AVS / SEM	EPA AVS/SEM SOP Version 2.0 (3)	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Pittsburgh
	TOC Lloyd Kahn	Plumb, 1981 Method (1)	GL 4oz. wide mouth	Cool 4°C	14 days	STL-Burlington
	Carbon Black	Accardi-Dey & Gschwend, 2003 Method (2)	GL 4oz. wide mouth	Cool 4°C	28 days	STL-Pittsburgh
	ASTM - grain size	ASTM D4139	GL 4oz. wide mouth	--	--	STL-Pittsburgh

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Section 4.0 - Sampling Method Requirements
Table 4-1. Sample Analysis Summary

Matrix	Analyses	Method	Bottle Ware	Preservation	Holding Times	Laboratory
	Chironomus tentans - 10 day toxicity test	EPA Method 100.2 (4)	GL 4oz. wide mouth	Cool 4°C	28 days	Aquatec Biological Science
	Hyalella azteca - 28 day toxicity test	Modified EPA Method 100.4 (5)	GL 4oz. wide mouth	Cool 4°C	28 days	Aquatec Biological Science
	Percent moisture	160.3	GL 4oz. wide mouth	--	--	
Tissue						
Fish	Percent lipids		Wrapped in aluminum foil and then plastic ziplock	Deep frozen and shipped in dry-ice	28 days	STL-Burlington
	PCB homologs / Congeners	Modified 8270 / 8082	Wrapped in aluminum foil and then plastic ziplock	Deep frozen and shipped in dry-ice	14 days	STL-Burlington
	Pesticides	8081A	Wrapped in aluminum foil and then plastic ziplock	Deep frozen and shipped in dry-ice	14 days	STL-Burlington
	Mercury	7471A	Wrapped in aluminum foil and then plastic ziplock	Deep frozen and shipped in dry-ice	28 days	STL-Burlington
Air						
Soil gas	VOCs	TO-15	6-liter SUMMA canister	capped securely	28 days	STL-Burlington
	Mercury	Modified 7471A (NIOSH 6009)	Hopcalite Tube	Cool 4°C tube capped and taped securely	28 days	STL - Sacramento

References:

- (1) Plumb, RH Jr., 1981. Procedure for handling and chemical analysis of sediment and water samples. Technical Report EPA/CE-81-1, Vicksburg, MS: USEPA/USACE Technical Committee on criteria for dredged and fill material, US Army Waterways Experimental Station.
- (2) Accardi-Dey, A. and Gschwend, P.M., 2003. Reinterpreting Literature Sorption Data Considering both Absorption into Organic Carbon and Adsorption onto Black Carbon. Environ. Sci. Technol. 37:99-106.
- (3) Environmental Research Laboratory at Narragansett EPA, AVS/SEM SOP Version 2.0
- (4) Guidelines of EPA/600/R-94/024: *Methods for Assessing the Toxicity of and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* Method 100.2.
- (5) Modification of the guidelines of EPA/600/R-99/064: *Methods for Assessing the Toxicity of and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* Second Edition, Method 100.4.

Section 7.0 – Analytical Procedures
Table 7-1. Volatile Organic Compounds - Reporting Limits

Volatile Organics (by SW-846 Method 8260B)	CAS Number	Reporting Limits ¹	
		Water (µg/L)	Solids (µg/kg)
Acetone	67-64-1	5.0	20
Benzene	71-43-2	1.0	5
Bromodichloromethane	75-27-4	1.0	5
Bromoform	75-25-2	1.0	5
Bromomethane	74-83-9	1.0	5
2-Butanone	78-93-3	5.0	5
Carbon disulfide	75-15-0	1.0	5
Carbon tetrachloride	56-23-5	1.0	5
Chlorobenzene	108-90-7	1.0	5
Dibromochloromethane	124-48-1	1.0	5
Chloroethane	75-00-3	1.0	5
Chloroform	67-66-3	1.0	5
Chloromethane	74-87-3	1.0	5
Cyclohexane	110-82-7	1.0	5
1,2-Dibromo-3-chloropropane	96-12-8	1.0	5
1,2-Dibromoethane	106-93-4	1.0	5
1,2-Dichlorobenzene	95-50-1	1.0	5
1,3-Dichlorobenzene	541-73-1	1.0	5
1,4-Dichlorobenzene	106-46-7	1.0	5
Dichlorodifluoromethane	75-71-8	1.0	5
1,1-Dichloroethane	75-34-3	1.0	5
1,2-Dichloroethane	107-06-2	1.0	5
cis-1,2-Dichloroethene	156-59-2	1.0	5
trans-1,2-Dichloroethene	156-60-5	1.0	5
1,1-Dichloroethene	75-35-4	1.0	5
1,2-Dichloropropane	78-87-5	1.0	5
cis-1,3-Dichloropropene	10061-01-5	1.0	5
trans-1,3-Dichloropropene	10061-02-6	1.0	5
Ethylbenzene	100-41-4	1.0	5
2-Hexanone	591-78-6	5.0	5
Isopropylbenzene	98-82-8	1.0	5
Methyl acetate	79-20-9	1.0	5
Methylcyclohexane	108-87-2	1.0	5
Methylene chloride	75-09-2	1.0	5
4-Methyl-2-pentanone	108-10-1	5.0	5
Methyl tert-butyl ether	1634-04-4	1.0	5
Styrene	100-42-5	1.0	5
1,1,2,2-Tetrachloroethane	79-34-5	1.0	5
Tetrachloroethene	127-18-4	1.0	5
Toluene	108-88-3	1.0	5
1,2,4-Trichlorobenzene	120-82-1	1.0	5
1,1,1-Trichloroethane	71-55-6	1.0	5
1,1,2-Trichloroethane	79-00-5	1.0	5
Trichloroethene	79-01-6	1.0	5
Trichlorofluoromethane	75-69-4	1.0	5
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1.0	5

Table 7-1. Volatile Organic Compounds - Reporting Limits (continued)

		Reporting Limits¹	
Volatile Organics		Water²	Solids
(by SW-846 Method 8260B)	CAS Number	(µg/L)	(µg/kg)
Vinyl Chloride	75-01-4	1.0	5
Xylenes (total)	1330-20-7	3.0	15

- 1 Specific reporting limits are highly matrix dependent. The reporting limits that are listed may not always be achievable.
- 2 Volatile organics in water will be performed as a 25 mL purge.

Section 7.0 – Analytical Procedures
Table 7-2. Semivolatile Organic Compounds - Reporting Limits

Semi-Volatile Organics (by SW-846 Method 8270C)	CAS Number	Reporting Limits ¹		
		Water (µg/L)	Solids - Low Level (µg/kg)	Solids - Med. Level (µg/kg)
Acenaphthene	83-32-9	10	6.67	330
Acenaphthylene	208-96-8	10	6.67	330
Acetophenone	98-86-2	10	6.67	330
Anthracene	120-12-7	10	6.67	330
Atrazine	1912-24-9	10	6.67	330
Benzaldehyde	100-52-7	10	6.67	330
Benzo(a)anthracene	56-55-3	10	6.67	330
Benzo(b)fluoranthene	205-99-2	10	6.67	330
Benzo(k)fluoranthene	207-08-9	10	6.67	330
Benzo(g,h,i)perylene	191-24-2	10	6.67	330
Benzo(a)pyrene	50-32-8	10	6.67	330
1,1'-Biphenyl	92-52-4	10	NA ^c	330
bis(2-Chloroethoxy)methane	111-91-1	10	100	330
bis(2-Chloroethyl)ether	111-44-4	10	100	330
bis-(2-Ethylhexyl)phthalate	117-81-7	10	50	330
4-Bromophenyl-phenyl ether	101-55-3	10	50	330
Butyl benzyl phthalate	85-68-7	10	50	330
Caprolactam	105-60-2	10	NA	330
Carbazole	86-74-8	10	50	330
4-Chloroaniline	106-47-8	10	150	330
4-Chloro-3-methylphenol	59-50-7	10	150	330
2-Chloronaphthalene	91-58-7	10	50	330
2-Chlorophenol	95-57-8	10	50	330
4-Chlorophenyl phenyl ether	7005-72-3	10	50	330
Chrysene	218-01-9	10	6.67	330
Dibenz (a,h)anthracene	53-70-3	10	6.67	330
Dibenzofuran	132-64-9	10	50	330
Di-n-butylphthalate	84-74-2	10	50	330
3,3'-Dichlorobenzidine	91-94-1	50	100	1600
2,4-Dichlorophenol	120-83-2	10	150	330
Diethyl phthalate	84-66-2	10	50	330
2,4-Dimethylphenol	105-67-9	10	150	330
Dimethyl phthalate	131-11-3	10	50	330
4,6-Dinitro-2-methylphenol	534-52-1	50	150	1600
2,4-Dinitrophenol	51-28-5	50	330	1600
2,4-Dinitrotoluene	121-14-2	10	200	330
2,6-Dinitrotoluene	606-20-2	10	200	330
Di-n-octylphthalate	117-84-0	10	50	330
1,4-Dioxane	123-91-1	2	6.7	67
Fluoranthene	206-44-0	10	6.67	330
Fluorene	86-73-7	10	6.67	330
Hexachlorobenzene	118-74-1	10	6.67	330
Hexachlorobutadiene	87-68-3	10	50	330
Hexachlorocyclopentadiene	77-47-4	50	330	1600
Hexachloroethane	67-72-1	10	50	330
Indeno(1,2,3-cd)pyrene	193-39-5	10	6.67	330
1,2-Dichlorobenzene	95-50-1	NA	50	NA
1,3-Dichlorobenzene	541-73-1	NA	50	NA

Table 7-2. Semivolatile Organic Compounds - Reporting Limits (continued)

Semi-Volatile Organics (by SW-846 Method 8270C)	CAS Number	Reporting Limits ¹		
		Water (µg/L)	Solids - Low Level (µg/kg)	Solids - Med. Level (µg/kg)
1,4-Dichlorobenzene	106-46-7	NA	50	NA
Isophorone	78-59-1	10	50	330
2-Methylnaphthalene	91-57-6	10	6.67	330
2-Methylphenol	95-48-7	10	200	330
4-Methylphenol	106-44-5	10	200	330
Naphthalene	91-20-3	10	6.67	330
2-Nitroaniline	88-74-4	50	200	1600
3-Nitroaniline	99-09-2	50	200	1600
4-Nitroaniline	100-01-6	50	200	1600
Nitrobenzene	98-95-3	10	100	330
2-Nitrophenol	88-75-5	10	50	330
4-Nitrophenol	100-02-7	50	330	1600
N-Nitrosodiphenylamine	86-30-6	10	50	330
N-Nitrosodi-n-propylamine	621-64-7	10	50	330
2,2'-oxybis(1-Chloropropane)		10	100	330
Pentachlorophenol	87-86-5	50	150	1600
Phenanthrene	85-01-8	10	6.67	330
Phenol	108-95-2	10	50	330
Pyrene	129-00-0	10	6.67	330
1,2,4-Trichlorobenzene	120-82-1	NA	50	NA
2,4,5-Trichlorophenol	95-95-4	10	150	330
2,4,6-Trichlorophenol	88-06-2	10	150	330

- 1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.
- 2 NA = Not Applicable

Section 7.0 – Analytical Procedures
Table 7-3. Metals - Reporting Limits

Metals	SW-846 Method	Reporting Limits¹	
		Water (µg/L)	Solids (mg/kg)
Aluminum	6010B	200	20
Antimony	6010B	10	1.0
Arsenic	6010B	10	1.0
Barium	6010B	200	20
Beryllium	6010B	4.0	0.4
Cadmium	6010B	5.0	0.5
Calcium	6010B	5000	500
Chromium	6010B	5	0.5
Cobalt	6010B	50	5.0
Copper	6010B	25	2.5
Iron	6010B	100	10
Lead	6010B	3.0	0.3
Magnesium	6010B	5000	500
Manganese	6010B	15	1.5
Mercury	7470A (water) 7471A (solids)	0.2	0.033
Nickel	6010B	40	4.0
Potassium	6010B	5000	500
Selenium	6010B	5.0	0.5
Silver	6010B	5	0.5
Sodium	6010B	5000	500
Thallium	6010B	10	1.0
Vanadium	6010B	50	5.0
Zinc	6010B	20	2.0

¹ Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.

Section 7.0 – Analytical Procedures
Table 7-4. Pesticides - Reporting Limits

Pesticides (by SW-846 Method 8081A)	CAS Number	Reporting Limits ¹	
		Water (µg/L)	Solids (µg/kg)
Aldrin	309-00-2	0.05	1.7
alpha-BHC	319-84-6	0.05	1.7
beta-BHC	319-85-7	0.05	1.7
delta-BHC	319-86-8	0.05	1.7
gamma-BHC (Lindane)	58-89-9	0.05	1.7
alpha-Chlordane	5103-71-9	0.05	1.7
gamma-Chlordane	5103-74-2	0.05	1.7
4,4'-DDD	72-54-8	0.05	1.7
4,4'-DDE	72-55-9	0.05	1.7
4,4'-DDT	50-29-3	0.05	1.7
Dieldrin	60-57-1	0.05	1.7
Endosulfan I	115-29-7	0.05	1.7
Endosulfan II	33213-65-9	0.05	1.7
Endosulfan sulfate	1031-07-8	0.05	1.7
Endrin	72-20-8	0.05	1.7
Endrin aldehyde	7421-93-4	0.05	1.7
Endrin ketone	53494-70-5	0.05	1.7
Heptachlor	76-44-8	0.05	1.7
Heptachlor epoxide	1024-57-3	0.05	1.7
Methoxychlor	72-43-5	0.1	3.3
Toxaphene	8001-35-2	2.0	67

1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.

Section 7.0 – Analytical Procedures
Table 7-5. Herbicides - Reporting Limits

Herbicides (by SW-846 Method 8151A)	CAS Number	Reporting Limits ¹	
		Water (µg/L)	Solids (µg/kg)
2,4-D	94-75-7	4.0	80
Dalapon	75-99-0	2.0	40.0
2,4-DB	94-82-6	4.0	80.0
Dicamba	1918-00-9	2.0	40
Dichlorprop	120-36-5	4.0	80.0
Dinoseb	88-85-7	0.6	12.0
MCPA	94-74-6	400	8000
MCPP	93-65-2	400	8000
Pentachlorophenol	87-86-5	1.0	10
Pichloram	1918-02-1	1.0	20
2,4,5-TP (Silvex)	93-72-1	1.0	20
2,4,5-T	93-76-5	1.0	20

1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.

Section 7.0 – Analytical Procedures
Table 7-6. PCBs - Reporting Limits

PCBs (by SW-846 Method 8082)	CAS Number	Reporting Limits ¹	
		Water (µg/L)	Solids (µg/kg)
Aroclor 1016	12674-11-2	1.0	33
Aroclor 1221	11104-28-2	1.0	33
Aroclor 1232	11141-16-5	1.0	33
Aroclor 1242	53469-21-9	1.0	33
Aroclor 1248	12672-29-6	1.0	33
Aroclor 1254	11097-69-1	1.0	33
Aroclor 1260	11096-82-5	1.0	33

1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.

Section 7.0 – Analytical Procedures
Table 7-7. Dioxins/Furans - Reporting Limits

Dioxins/Furans (by SW-846 Method 8290)	CAS Number	Reporting Limits ¹	
		Water (pg/L)	Solids (pg/g)
2,3,7,8-TCDD	1746-01-6	10	1
2,3,7,8-TCDF	51207-31-9	10	1
1,2,3,7,8-PeCDD	40321-76-4	50	5
1,2,3,7,8-PeCDF	57117-41-6	50	5
2,3,4,7,8-PeCDF	57117-31-4	50	5
1,2,3,4,7,8-HxCDD	39227-28-6	50	5
1,2,3,6,7,8-HxCDD	57653-85-7	50	5
1,2,3,7,8,9-HxCDD	19408-74-3	50	5
1,2,3,4,7,8-HxCDF	70648-26-9	50	5
1,2,3,6,7,8-HxCDF	57117-44-9	50	5
2,3,4,6,7,8-HxCDF	60851-34-5	50	5
1,2,3,7,8,9-HxCDF	72918-21-9	50	5
1,2,3,4,6,7,8-HpCDD	35822-46-9	50	5
1,2,3,4,6,7,8-HpCDF	67562-39-4	50	5
1,2,3,4,7,8,9-HpCDF	55673-89-7	50	5
OCDD	3268-87-9	100	10
OCDF	39001-02-0	100	10

1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.

Section 7.0 – Analytical Procedures
Table 7-8. VOCs in Air - Reporting Limits

Volatile Organics (Method TO-15)^b	CAS Number	Reporting Limits¹ Air (µg/m³)
Acetone (2-propanone)	67-64-1	12
Benzene	71-43-2	0.64
Bromodichloromethane	75-27-4	1.3
Bromoethene	593-60-2	0.87
Bromoform	75-25-2	2.1
Bromomethane (Methyl bromide)	74-83-9	0.78
1,3-Butadiene	106-99-0	1.11
2-Butanone (Methyl ethyl ketone)	78-93-3	1.5
Carbon disulfide	75-15-0	1.6
Carbon tetrachloride	56-23-5	1.3
Chlorobenzene	108-90-7	0.92
Chloroethane	75-00-3	1.32
Chloroform	67-66-3	0.98
Chloromethane (Methyl chloride)	74-87-3	1.03
3-Chloropropene (allyl chloride)	107-05-1	1.57
2-Chlorotoluene (o-Chlorotoluene)	95-49-8	1.04
Cyclohexane	110-82-7	0.69
Dibromochloromethane	124-48-1	1.7
1,2-Dibromoethane	106-93-4	1.5
1,2-Dichlorobenzene	95-50-1	1.2
1,3-Dichlorobenzene	541-73-1	1.2
1,4-Dichlorobenzene	106-46-7	1.2
Dichlorodifluoromethane (Freon 12)	75-71-8	2.47
1,1-Dichloroethane	75-34-3	0.81
1,2-Dichloroethane	107-06-2	0.81
1,1-Dichloroethene	75-35-4	0.79
1,2-Dichloroethene (cis)	156-59-2	0.79
1,2-Dichloroethene (trans)	156-60-5	0.79
1,2-Dichloropropane	78-87-5	0.92
cis-1,3-Dichloropropene	10061-01-5	0.91
trans-1,3-Dichloropropene	10061-02-6	0.91
1,2-Dichlorotetrafluoroethane (Freon 114)	76-14-2	1.4
Ethylbenzene	100-41-4	0.87
4-Ethyltoluene (p-Ethyltoluene)	622-96-8	0.98
n-Heptane	142-82-5	0.83
Hexachlorobutadiene	87-68-3	2.1
n-Hexane	110-54-3	1.76
Methylene chloride	75-09-2	1.7
4-Methyl-2-pentanone (MIBK)	108-10-1	2.05
Methyl tert-butyl ether (MTBE)	1634-04-4	1.8
Styrene	100-42-5	0.85
Tertiary butyl alcohol (TBA)	75-65-0	15
1,1,2,2-Tetrachloroethane	79-34-5	1.4
Tetrachloroethene (PCE)	127-18-4	1.4
Toluene	108-88-3	0.75
1,2,4-Trichlorobenzene	120-82-1	3.7
1,1,1-Trichloroethane	71-55-6	1.1
1,1,2-Trichloroethane	79-00-5	1.1

Section 7.0 – Analytical Procedures
Table 7-8. VOCs in Air - Reporting Limits (continued)

Volatile Organics (Method TO-15) ²	CAS Number	Reporting Limits ^a Air (µg/m ³)
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon TF)	76-13-1	1.5
Trichloroethene (TCE)	79-01-6	1.07
Trichlorofluoromethane (Freon 11)	75-69-4	1.1
1,2,4-Trimethylbenzene	95-63-6	0.98
1,3,5-Trimethylbenzene	108-67-8	0.98
2,2,4-Trimethylpentane	540-84-1	0.93
Vinyl chloride	75-01-4	0.51
Xylenes (m&p)	1330-20-7	2.17
Xylenes (o)	95-47-6	0.87
1,2-Dichloroethene (total)	540-59-0	0.79
1,4-Dioxane	123-91-1	18
Isopropyl Alcohol	67-63-0	12.5
Methyl Butyl Ketone	591-78-6	2.05
Methyl methacrylate (upon request only)	80-62-6	2.05
Naphthalene (upon request only)	91-20-3	2.6
Tetrahydrofuran	109-99-9	15

- 1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.
- 2 This method was prepared for publication in the *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition* (EPA/625/R-96/010b).

Section 7.0 – Analytical Procedures
Table 7-9. AVS/SEM Metals - Reporting Limits

Analyte/Compound	EPA Method (Version 2.0)	Reporting Limits¹
		Solids (µmoles/gn)
Acid Volatile Sulfide	AVS ² in Sediment	0.499
Cadmium	SEM ³ in Sediment	0.001112
Copper	SEM ³ in Sediment	0.009835
Lead	SEM ³ in Sediment	0.0007239
Nickel	SEM ³ in Sediment	0.01704
Zinc	SEM ³ in Sediment	0.03823

1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.

2 AVS = Acid Volatile Sulfide method

3 SEM = Simultaneously Extractable Metals method

References:

Environmental Research Laboratory at naragansett, EPA, AVS/SEM SOP Version 2.0.

Section 7.0 – Analytical Procedures

Table 7-10. PCB Homologues and Selected Congeners in Fish - Reporting Limits

PCB Homologues/Congeners		Reporting Limits ¹
(Modified EPA Method 680)	CAS Number	Solids (µg/kg wet wt.)
Monochlorobiphenyl	27323-18-8	0.21* – 0.67
Dichlorobiphenyl	25512-42-9	0.21* – 1.7
Trichlorobiphenyl	25323-68-6	0.21* – 5.0
Tetrachlorobiphenyl	26914-33-0	0.21* – 5.7
Pentachlorobiphenyl	25429-29-2	0.21* – 5.7
Hexachlorobiphenyl	26601-64-9	0.21* – 5.7
Heptachlorobiphenyl	28655-71-2	0.21* – 5.0
Octachlorobiphenyl	52663-78-2	0.21* – 1.7
Nonachlorobiphenyl	40186-72-9	0.21* – 1.7
Decachlorobiphenyl (209)	2051-24-3	0.42* – 0.66.
Total Homologues		2.31* – 33
PCB 77	32598-13-3	0.67
PCB 81	70362-50-4	0.67
PCB 105	32598-14-4	0.67
PCB 114	74472-37-0	0.67
PCB 118	31508-00-6	0.67
PCB 123	65510-44-3	0.67
PCB 126	57465-28-8	0.67
PCB 127	39635-33-1	0.67
PCB 156	38380-08-4	0.67
PCB 157	69782-90-7	0.67
PCB 167	52663-72-6	0.67
PCB 169	32774-16-6	0.67
PCB 189	39635-31-9	0.67

1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.

* Lower limits of calibration response – the calibration is performed with the first and last eluting congener for each homologue group. Based on the concentration of a single congener, the lower limit of calibration is equivalent to 0.21 µg/kg. The concentration of each individual congener in the low calibration standard is 12.5 ng/mL. Given an extraction of 30 grams and a final extract volume of 0.5 mL, this would equate to a concentration of 0.21 µg/kg. The exception to this is decachlorobiphenyl, for which the concentration in the low calibration standard is 25.0 ng/mL. For this congener, the lower limit of calibration is equivalent to 0.42 µg/kg.

Section 7.0 – Analytical Procedures
Table 7-11. Miscellaneous - Reporting Limits

Miscellaneous	EPA Method	Reporting Limits ¹	
		Water (mg/L)	Solids (mg/kg)
Alkalinity (total)	310.1 ²	5.0	NA ⁴
Ammonia nitrogen	350.1 ²	0.10	NA
Cyanide (total)	9012A ³	0.01	0.5
Hexavalent chromium	7196A ³	0.01	0.4
Nitrate/nitrite as N	353.2 ²	0.1	NA
Phosphorus (total)	365.2 ²	0.1	NA
Recoverable phenolics (total)	9066 ³	0.01	0.2
Total Organic Carbon (Lloyd Kahn)	Plumb, 1981	—	0.05
Black carbon	Accardi-Dey & Gschwend, 2003 Method	---	0.05

- 1 Specific detection limits are highly matrix dependent. The detection limits that are listed may not always be achievable.
- 2 From the EPA Methods for Chemical Analysis of Water and Waste (MCAWW)
- 3 From the EPA SW-846 methods
- 4 NA = Not Applicable

References:

Plumb, RH Jr., 1981. Procedure for handling and chemical analysis of sediment and water samples. Technical Report EPA/CE-81-1, Vicksburg, MS: USEPA/USACE Technical Committee on criteria for dredged and fill material, US Army Waterways Experimental station.

Accardi-Dey, A. and Gschwend, P.M., 2003. Reinterpreting Literature Sorption Data Considering both Absorption into Organic Carbon and Adsorption onto Black Carbon.

Environ. Sci. Technol. 37:99-106.

Attachment A
Laboratory Quality Manuals

Attachment B
THA and Hazard Assessment Documents



SUBSURFACE CLEARANCE PROCEDURE CHECKLIST

All subsurface incidents must be reported to ERM Project or Field Manager, ERM PIC, and the client contact.

Site Identification: _____

(ERM-MANAGED SUBSURFACE CLEARANCE ACTIVITIES)	Yes	No	N/A	COMMENTS INCLUDING JUSTIFICATION IF RESPONSE IS NO OR NOT APPLICABLE
Preparation Tasks				
ERM PM automatically serving as "Designated Person" /or alternate is designated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ERM "Designated Person" :
HASP includes subsurface clearance items: <ul style="list-style-type: none"> Potential subsurface clearance issues Emergency shutoff location(s) 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Preventative measures Emergency response resources identified Incident notification contacts
Most recent as-built drawings and/or site plans obtained and historical information reviewed: <ul style="list-style-type: none"> Easements and right-of-ways Historical site plans, fire insurance plans 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Tank dip charts Previous site investigations, soil surveys, and boring logs Aerial photographs
Site walkover conducted and above-ground indicators of underground utilities mapped: <ul style="list-style-type: none"> Area lights and signs Phone Lines Drainlines Electrical junction boxes and lines Natural gas meters and lines Water meters and lines 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Sewer drop inlets, manholes, and cleanouts Fire hydrants Sprinkler systems Steamlines Tankfield fillports, observation wells, vent stacks Pipeline/cable markers Pavement scars
Public utility mark-out(s) completed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Private subsurface structure mark-out completed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Subsurface clearance methods approved by ERM "Designated Person"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Critical zones defined - 10 feet (3 meters) distance from edge of underground lines and infrastructure. <i>Identify critical zones defined:</i> <ul style="list-style-type: none"> Tanks, dispenser islands, and piping manifolds Pumps pump galleries 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Production wells Loading racks Process equipment On/below grade transformers Compressors Suspected underground lines and utilities Other:
Subsurface Clearance Tasks				
Subsurface clearance procedures reviewed with appropriate on-site personnel.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If conducting borehole advancement activities: First 4 feet (1.3 meter, or frost depth if deeper) has been delineated. <i>Note methods used.</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Probing Hand digging Other: <ul style="list-style-type: none"> Hand augering Vacuum excavation
Critical Zones: Second 3 feet (total of 7 feet (2.3 meters)) has been delineated. <i>Note methods used.</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Probing Hand digging Other: <ul style="list-style-type: none"> Hand augering Vacuum excavation
If conducting trenching/excavation activities in critical zone: First 4 feet (1.3 m or frost depth if deeper) assessed for below grade issues.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Probing Hand digging Other: <ul style="list-style-type: none"> Hand augering Vacuum excavation
If subsurface structures exposed, notified ERM "Designated Person" and client.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Completed by: _____

"Designated Person" _____

Name

Name

Date

Date



Task Hazard Analysis Worksheet

In assessing the potential hazards, determine if one task description/ analysis is sufficient. If not, then develop additional task assessments with their own steps.

Task Description (Sequence of Steps):

1.
2.
3.
4.
5.
6.

Check Applicable Task Hazard	Check the Planned or Recommended Hazard Control (write in others)
<input type="checkbox"/> Asphyxiation	<input type="checkbox"/> Ventilation <input type="checkbox"/> Supplied Air <input type="checkbox"/> Air monitoring
<input type="checkbox"/> Chemical Exposure	<input type="checkbox"/> Isolation, Lockout/Tagout <input type="checkbox"/> PPE <input type="checkbox"/> Respiratory Protection <input type="checkbox"/> Decontamination/ eyewash/ shower
<input type="checkbox"/> Plant, Insect, Animal Hazards	<input type="checkbox"/> Knowledge of particular local issues <input type="checkbox"/> Repellent sprays and coatings <input type="checkbox"/> Netting, clothing covering <input type="checkbox"/> Self-inspection schedule <input type="checkbox"/> First aid kit
<input type="checkbox"/> Thermal Burns <input type="checkbox"/> Hot Surface	<input type="checkbox"/> Splash Guard <input type="checkbox"/> Isolation, Lockout/Tagout <input type="checkbox"/> PPE <input type="checkbox"/> Equipment Covers <input type="checkbox"/> Barricades
<input type="checkbox"/> Slips and Trips	<input type="checkbox"/> Ensure clean and dry surface <input type="checkbox"/> Barricade <input type="checkbox"/> Walk Carefully/ Eyes on Path <input type="checkbox"/> Use alternate route if wet or unstable situation <input type="checkbox"/> Relocate the trip hazards
<input type="checkbox"/> Falls <input type="checkbox"/> More than 4 feet	<input type="checkbox"/> Fall restraint, guardrails, barricades, short lanyard
<input type="checkbox"/> Electrical shock	<input type="checkbox"/> Isolation, LOTO <input type="checkbox"/> Testing <input type="checkbox"/> Grounding <input type="checkbox"/> Shielding on equipment <input type="checkbox"/> PPE <input type="checkbox"/> Ground Fault Interruption on cords <input type="checkbox"/> Electrical expertise on project team
<input type="checkbox"/> Airborne/Flying material	<input type="checkbox"/> Cover/Shield source <input type="checkbox"/> PPE, Eye & Face <input type="checkbox"/> PPE, Arms & Body <input type="checkbox"/> Positioning
<input type="checkbox"/> Fire/ Explosion	<input type="checkbox"/> Isolation/LOTO <input type="checkbox"/> Air testing/monitoring <input type="checkbox"/> Control sources of ignition <input type="checkbox"/> Implement a "Hot Work" process <input type="checkbox"/> PPE <input type="checkbox"/> The correct fire extinguisher is available
<input type="checkbox"/> Heat/Cold Stress	<input type="checkbox"/> Ventilation <input type="checkbox"/> Cooling vests, etc. <input type="checkbox"/> Task rotation, Shared tasks <input type="checkbox"/> Work/Rest regimen <input type="checkbox"/> Planned place for sheltering
<input type="checkbox"/> High Noise	<input type="checkbox"/> Hearing Protection <input type="checkbox"/> Relocate Work <input type="checkbox"/> Muffle Source
<input type="checkbox"/> Poor Visibility	<input type="checkbox"/> Illumination is adequate for task <input type="checkbox"/> Nighttime considerations if the job could extend past daylight hours

<input type="checkbox"/> Lifting, pulling, pushing	<input type="checkbox"/> A plan is in place (people, devices, carts) <input type="checkbox"/> Handling equipment is designed for the job <input type="checkbox"/> Proper technique known/ discussed <input type="checkbox"/> Smaller, lighter loads?
<input type="checkbox"/> Repetitive motion	<input type="checkbox"/> Proper technique known/ discussed <input type="checkbox"/> Proper tools, rather than manual <input type="checkbox"/> Get help, take breaks
<input type="checkbox"/> Rotating equipment/ Pinch Points	<input type="checkbox"/> Isolation, LOTO <input type="checkbox"/> Guarding, Barricading <input type="checkbox"/> No loose clothing <input type="checkbox"/> Positioning
<input type="checkbox"/> Sharp objects	<input type="checkbox"/> Guarding <input type="checkbox"/> Gloves, safety shoes or boots <input type="checkbox"/> Substitute safe cutter for blade
<input type="checkbox"/> Falling objects	<input type="checkbox"/> Secure objects <input type="checkbox"/> Guarding, covers <input type="checkbox"/> Hard Hat <input type="checkbox"/> Barricading
<input type="checkbox"/> Hazards from others working in vicinity (particularly heavy equipment)	<input type="checkbox"/> Communication <input type="checkbox"/> Barricading <input type="checkbox"/> Shielding
<input type="checkbox"/> Hazards to other working in vicinity	<input type="checkbox"/> Communication <input type="checkbox"/> Barricading <input type="checkbox"/> Shielding
<input type="checkbox"/> Environmental Spill	<input type="checkbox"/> Containment <input type="checkbox"/> Waste Plan <input type="checkbox"/> Waste Containers <input type="checkbox"/> Other
<input type="checkbox"/> Chemical Storage	<input type="checkbox"/> Container labeling and MSDSs <input type="checkbox"/> Incompatibles (acids/bases, flammables/oxidizers) considered <input type="checkbox"/> Control physical damage to containers
<input type="checkbox"/> Drowning	<input type="checkbox"/> Personal Floatation Device <input type="checkbox"/> Barricading <input type="checkbox"/> Working with a partner <input type="checkbox"/> Alerting Devices
<input type="checkbox"/> Ionizing Radiation	<input type="checkbox"/> Exposure Monitoring <input type="checkbox"/> PPE <input type="checkbox"/> Distance and/or shielding
<input type="checkbox"/> Nearby Road Traffic	<input type="checkbox"/> Bright colored work vests <input type="checkbox"/> Planned avoidance of traffic areas <input type="checkbox"/> Signs and lights to alert drivers
<input type="checkbox"/> Contact with underground utilities	<input type="checkbox"/> Local Utility "One Call" service <input type="checkbox"/> Access to site maps/ experience <input type="checkbox"/> Utility Line Locating Devices <input type="checkbox"/> Utility Company Knowledge: <input type="checkbox"/> Hand Auguring before mechanical
<input type="checkbox"/> Hazards not listed	List Hazard Controls

	YES	NO	N/A
Is a permit (Hot Work, Confined Space Entry, Process Line Breaking, and LOTO) required for this ERM work task?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If so is the client's procedure/policy supplied?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you have the proper tools and/or equipment in good condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Have you planned an escape route?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Was this Hazard Analysis reviewed with the project team performing this task?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Developed By (Individual or Team Members) Names:

Date Developed:

Reviewed with the Following Project Employees:

GENERIC RISK ASSESSMENT

Geoprobe Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Employees of auger operation contractor / ERM employees	Accident or incident due to lack of training	<ul style="list-style-type: none"> - Work should be done by qualified employees - Full briefing beforehand - Supervision
Geoprobe equipment	Incident or Accident due to a defect	<ul style="list-style-type: none"> - Machine needs to be checked by client before start of operation - Machine needs to be sealed with the required inspection certification
	Risk of getting feet stuck	<ul style="list-style-type: none"> - Emergency shutdown - Everyone needs to know where the emergency shutdown is located - Prohibit the wearing of loose jewelry - Overalls should be well-fitted - Scarves should be tucked into overalls
	Hitting head against hammer block	<ul style="list-style-type: none"> - Personal protective equipment: hard hat
Geoprobe equipment	Hitting tubing or boring elements	<ul style="list-style-type: none"> - Personal protective equipment: overalls, appropriate safety shoes
	Injury to fingers	<ul style="list-style-type: none"> - Gloves - No jewelry on fingers
	Ocular injury	<ul style="list-style-type: none"> - Safety glasses
	Noise	<ul style="list-style-type: none"> - Ear protection

GENERIC RISK ASSESSMENT

Geoprobe Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
	Drilling through/hitting existing cables or pipes	<ul style="list-style-type: none"> - Consult with client in advance - Request utility plan - Walkover drilling locations with client - Signing of drilling plan by client - Use cable detection apparatus - Do manual test drilling
Geoprobe equipment	Hitting the electrical and phone cables above-ground as a result of driving with a raised mast	<ul style="list-style-type: none"> - Lower mast before changing locations - Assistance should be provided during location change on site
Carrier gas	Leakage can cause explosion	<ul style="list-style-type: none"> - Installation check to be carried out by manufacturer/contractor before start of operation
Truck	Sinking due to ground instability	<ul style="list-style-type: none"> - Park truck on stable ground
Plastic tubing	Intoxication due to contaminated groundwater	<ul style="list-style-type: none"> - Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Plastic pipes	Intoxication due to contaminated groundwater	<ul style="list-style-type: none"> - Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Small tools: hammer, screwdriver, ...	Minor injuries	<ul style="list-style-type: none"> - Personal protective equipment: wear working gloves if necessary - Have first aid kit available

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GENERIC RISK ASSESSMENT

Geoprobe Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Biological agents in the soil	Tetanus, Hepatitis A intoxication (sampling of sewerage)	<ul style="list-style-type: none"> - Vaccination - Use PPE (gloves) - Hygiene
Weather influences	Risk of electric shock during thunderstorm	<ul style="list-style-type: none"> - Lower mast and halt operation
	Too hot / Sunstroke / Dehydration / Sunburn / Photo allergy (PAK's)	<ul style="list-style-type: none"> - Appropriate Personal protective equipment: hat, sunscreen - Provide drinking water / soda
	Snow / ice / too cold / hypothermia	<ul style="list-style-type: none"> - Appropriate Personal protective equipment: winter clothing
	Hypothermia due to rain	<ul style="list-style-type: none"> - Wear appropriate rain gear
Interference with site operations	Accidents / Incidents	<ul style="list-style-type: none"> - Consult with client in advance - Follow instructions given by site officer - Clear work area - Wear safety vest - Do not touch anything without permission

GENERIC RISK ASSESSMENT

Geoprobe Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Contaminated soil	Intoxication due to contaminated soil	<ul style="list-style-type: none">- Personal protective equipment: gloves, overalls, face protection, safety shoes- Measure with PID- Hygiene
Contaminated soil	Intoxication due to contaminated soil	<ul style="list-style-type: none">- Appropriate medical supervision
Contaminated groundwater	Intoxication due to contaminated groundwater	<ul style="list-style-type: none">- Personal protective equipment: gloves, overalls, face protection, safety shoes- Measure with PID- Hygiene- Appropriate medical supervision
Harmful gasses	Intoxication due to harmful gasses	<ul style="list-style-type: none">- Measure with PID- Halt operation- Consult work plan with site contact- Change drilling location- Personal protective equipment: respiratory protection (full face mask with an ABEK P3 filter)- Appropriate medical supervision

AR100140

GENERIC RISK ASSESSMENT

Geoprobe Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Filter sand or gravel	Back injury due to package handling	- Use 25 kg packaging - Lifting technique and back schooling
Bentonite/cement	Back injury due to package handling	- Use 25 kg packaging - Lifting technique and back schooling
Bentonite/cement	Drying of skin	- Personal protective equipment: gloves, overalls, face protection, safety shoes
Employees of auger operation contractor / ERM employees	Accident or incident due to employees' lack of training	- Allow operation to be carried out by trained personnel
Work related stress	Accidents or incidents due to stressful activities	- Give realistic tasks - Plan realistically
Image (investigators scare off clients by wearing typical white suit)	Intoxication as a result of not wearing PPE (white tyveks)	- Inform client - Wear tyvek
General	Third party exposure	- Clear work area
Other		
Other		

AR100141

GENERIC RISK ASSESSMENT

Assessment Renewal By/With _____

Date _____

AR100142

GENERIC RISK ASSESSMENT

Groundwater Sampling (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Sampling contractor personnel / ERM employees	Accident or incident due to employees' lack of training	<ul style="list-style-type: none"> - Work should be done by trained personnel - Full briefing beforehand - Supervision
Grundfos submersible pump	Electric shock	<ul style="list-style-type: none"> - Check pump cables before sampling
	Intoxication due to contaminated groundwater	<ul style="list-style-type: none"> - Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Peristaltic pump	Intoxication due to contaminated groundwater	<ul style="list-style-type: none"> - Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Generator	Burn wounds	<ul style="list-style-type: none"> - Check and isolate
	Electric shock	<ul style="list-style-type: none"> - Check and protect socket before operation start-up
Flow through cell	Intoxication due to contaminated groundwater	<ul style="list-style-type: none"> - Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Sampling containers (partially acidified)	Intoxication due to contaminated groundwater	<ul style="list-style-type: none"> - Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
	Intoxication / burn wounds as a result of acids	
Plastic tube	Intoxication due to contaminated groundwater	<ul style="list-style-type: none"> - Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes

AR100143

GENERIC RISK ASSESSMENT

Groundwater Sampling (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
PH, EC and DO meter	Intoxication due to contaminated groundwater	- Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Test kit for Fe ³⁺ /Fe ²⁺	Intoxication due to acids	- Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Small tools: hammer, screwdriver, ...	Minor injuries	- Personal protective equipment: wear working gloves if necessary - Have First aid kit available
Biological agents in the soil	Tetanus, Hepatitis A intoxication (sampling of sewerage)	- Vaccination - Use PPE (gloves) - Hygiene
Weather influences	Risk of electric shock during thunderstorm	- Halt operation
Weather influences	Too hot / Sunstroke / Dehydration / Sunburn / Photo allergy (PAKs)	- Appropriate Personal protective equipment: hat, sunscreen - Supply drinking water / soda
	Snow / ice / too cold / hypothermia	- Appropriate Personal protective equipment: winter clothing
	Hypothermia due to rain	- Wear appropriate rain gear

GENERIC RISK ASSESSMENT

Groundwater Sampling (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Interference with site operation	Accidents / Incidents	<ul style="list-style-type: none"> - Consult with client in advance - Follow instructions given by site officer - Clear work area - Wear safety vest - Do not touch anything without permission
Contaminated groundwater	Intoxication due to contaminated groundwater	<ul style="list-style-type: none"> - Personal protective equipment: gloves, overalls, face protection, safety shoes - Measure with PID - Hygiene - Appropriate medical supervision
Harmful gasses	Intoxication due to concentrated gasses in the monitoring well	<ul style="list-style-type: none"> - Do not smell the monitoring wells - Use PID - Allow gasses to escape by opening the monitoring well slowly - Personal protective equipment: respiratory protection (full face mask with an ABEK P3 filter) - Appropriate medical supervision
Employees of auger operation contractor / ERM employees	Accident of incident due to employees' lack of training	<ul style="list-style-type: none"> - Allow operation to be carried out by trained personnel

AR100145

GENERIC RISK ASSESSMENT

Groundwater Sampling (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Work related stress	Accidents or incidents due to stressful activities	- Give realistic tasks - Plan realistically
General	Third party exposure	- Clear work area
Other		
Other		

Assessment Renewal By/With _____

Date _____

GENERIC RISK ASSESSMENT

Hand Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Employees of augering operation contractor / ERM employees	Accident or incident due to lack of training	<ul style="list-style-type: none"> - Work should be done by qualified employees - Full briefing beforehand - Supervision
Manual auger (Edelman auger)	Back injury due to the turning movements of auger	<ul style="list-style-type: none"> - Appropriate posture - Avoid pulling and dragging - Take a sufficient break
	Arm injury due the turning movements of auger	<ul style="list-style-type: none"> - Avoid pulling and dragging - Take a sufficient break
	Back injury due to pulling back the tubing or boring elements	<ul style="list-style-type: none"> - Pull back auger or tubing using pulling machine or with two people - Always allow the same team to operate together
Manual auger (Edelman auger)	Drilling through/hitting existing cables or pipes	<ul style="list-style-type: none"> - Consult with client beforehand - Request utility plan - Signing of drilling plan by client - Use cable detection apparatus - Do a manual test drilling
Manual auger extensions	Injury to hands during the assembly jointing pieces	<ul style="list-style-type: none"> - Use gloves
Manual auger extensions	Third party injury/ material damage due to installation of new extensions or while pulling back the auger	<ul style="list-style-type: none"> - Clear work area

AR100147

GENERIC RISK ASSESSMENT

Hand Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Plastic tubing	Intoxication due to contaminated groundwater	- Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Plastic pipes	Intoxication due to contaminated groundwater	- Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Small tools: hammer, screwdriver, ...	Minor injuries	- Personal protective equipment: use working gloves if necessary - First aid kit available
Biological agents in the soil	Tetanus, Hepatitis A intoxication (due to sewerage sampling)	- Vaccination - Use PPE (gloves) - Hygiene
Weather influences	Risk of electric shock during thunderstorm	- Stop operation
	Too hot / Sunstroke / Dehydration / Sunburn / Photo allergy (PAK's)	- Appropriate Personal protective equipment: hat, sunscreen - Supply drinking water / soda
	Snow / ice / too cold / hypothermia	- Appropriate Personal protective equipment: winter clothing
	Hypothermia due to rain	- Appropriate rain gear

GENERIC RISK ASSESSMENT

Hand Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Interference with site operations	Accidents / incidents	<ul style="list-style-type: none">- Consult with client in advance- Follow instructions given by site officer- Clear work area- Wear safety vest- Do not touch anything without permission
Contaminated soil	Intoxication due to contaminated soil	<ul style="list-style-type: none">- Personal protective equipment: gloves, overalls, face protection, safety shoes- Measure using PID- Hygiene- Appropriate medical supervision
Contaminated groundwater	Intoxication due to contaminated ground water	<ul style="list-style-type: none">- Personal protective equipment: gloves, overalls, face protection, safety shoes- Measure using PID- Hygiene- Appropriate medical supervision
Harmful gasses	Intoxication due to harmful gasses	<ul style="list-style-type: none">- Measure using PID- Halt operation- Consult work plan with site contact

AR100149

GENERIC RISK ASSESSMENT

Hand Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Harmful gasses	Intoxication due to harmful gasses	<ul style="list-style-type: none"> - Change drilling location - Personal protective equipment: respiratory protection (full face mask with an ABEK P3 filter) - Appropriate medical supervision
Filter sand or gravel	Back injury caused by lifting packages	<ul style="list-style-type: none"> - Use 25 kg packaging - Lift technique or back schooling
Bentonite/cement	Back injury caused by lifting packages	<ul style="list-style-type: none"> - Use 25 kg packaging - Lift technique or back schooling
Bentonite/cement	Drying of skin	<ul style="list-style-type: none"> - Personal protective equipment: gloves, overalls, face protection, safety shoes
Employees of augering operation contractor / ERM employees	Accident or incident due to employees' lack of training	<ul style="list-style-type: none"> - Operation should be carried out by trained personnel
Work related stress	Accidents or incidents due to stressful activities	<ul style="list-style-type: none"> - Give realistic tasks - Plan realistically
Image (scaring off the client by wearing typical white suit)	Intoxication as a result of not wearing PPE (white tyveks)	<ul style="list-style-type: none"> - Inform client - Wear tyvek
General	Third party exposure	<ul style="list-style-type: none"> - Clear work area
Other		

GENERIC RISK ASSESSMENT

Hand Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Other		

Assessment Renewal By/With _____

Date _____

GENERIC RISK ASSESSMENT

Hollow Stem Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Employees of auger operation contractor / ERM employees	Accident or incident due to lack of training	<ul style="list-style-type: none"> - Work should be carried out by trained personnel - Full briefing beforehand - Supervision
Hollow stem auger	Incident of Accident as a result of defective boring tower	<ul style="list-style-type: none"> - Checked by contractor prior to operation - Machine needs to be sealed with inspection certification
	Risk of getting clothing and jewelry stuck due to the turning of the hollow stem auger	<ul style="list-style-type: none"> - Emergency shutdown - Everyone needs to know where emergency shutdown is located - Prohibit the wearing of loose jewelry - Overalls should be well-fitted - Scarf needs to be tucked into overalls
	Hitting head against hammer block	<ul style="list-style-type: none"> - Personal protective equipment: hard hat
Hollow stem auger	Hitting tubing or boring elements	<ul style="list-style-type: none"> - Personal protective equipment: overalls, appropriate safety shoes
	Back injury due to manipulation of the tubing or boring elements	<ul style="list-style-type: none"> - Use hoisting device on the boring tower
	Injuries to fingers	<ul style="list-style-type: none"> - Gloves - No jewelry on fingers

AR100152

GENERIC RISK ASSESSMENT

Hollow Stem Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
	Arm injuries due to manipulation of the tubing or boring elements	- Use hoisting device on the boring tower
	Drilling through/hitting existing cables or pipes	<ul style="list-style-type: none"> - Consult with client in advance - Request utility plans - Walkover drilling locations with client - Signing of drilling plan by client - Use cable detection apparatus - Do a manual test drilling
	Noise	Ear protection
Hollow stem auger	Hitting electricity and phone cables located above ground as a result of driving with a raised mast	<ul style="list-style-type: none"> - Before changing locations, lower the mast - Location change at the site, requires assistance
Trucks	Sinking due to ground instability	- Park truck on stable ground
Plastic tubing	Intoxication due to contaminated groundwater	- Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Plastic pipes	Intoxication due to contaminated groundwater	- Personal protective equipment: gloves (nitrile rubber, polyvinyl alcohol, viton), overalls, face protection, safety shoes
Small tools: hammer, screwdriver, ...	Minor injuries	<ul style="list-style-type: none"> - Personal protective equipment: wear working gloves, if necessary - Have first aid kit available

AR100153

GENERIC RISK ASSESSMENT

Hollow Stem Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Biological agents in soil	Tetanus, Hepatitis A intoxication (sampling of sewerage)	<ul style="list-style-type: none"> - Vaccination - Use PPE (gloves) - Hygiene
Weather influences	Electric shock risk during thunderstorm	- Lower mast and stop operation
	Too hot / Sunstroke / Dehydration / Sunburn / Photo allergy (PAK's)	<ul style="list-style-type: none"> - Appropriate Personal protective equipment: hat, sunscreen - Supply drinkable water / soda
	Snow / Ice / too cold / hypothermia	- Appropriate Personal protective equipment: winter clothing
	Hypothermia due to rain	- Wear appropriate rain gear
Interference with site operations	Accidents / incidents	<ul style="list-style-type: none"> - Consult with client in advance - Follow instructions given by site officer - Clear work area - Wear safety vest - Do not touch anything without permission

GENERIC RISK ASSESSMENT

Hollow Stem Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Contaminated soil	Intoxication due to contaminated soil	<ul style="list-style-type: none">- Personal protective equipment: gloves, overalls, face protection, safety shoes- Measure with PID- Hygiene- Appropriate medical supervision
Contaminated groundwater	Intoxication due to contaminated groundwater	<ul style="list-style-type: none">- Personal protective equipment: gloves, overalls, face protection, safety shoes- Measure with PID- Hygiene- Appropriate medical supervision
Harmful gasses	Intoxication due to harmful gasses	<ul style="list-style-type: none">- Measure with PID- Stop operation- Consult action plan with site contact- Change drilling location
Harmful gasses	Intoxication due to harmful gasses	<ul style="list-style-type: none">- Personal protective equipment: respiratory protection (full face mask with an ABEK P3 filter)- Appropriate medical supervision
Filter sand or gravel	Back injury due to package handling	<ul style="list-style-type: none">- Use 25 kg packaging- Lifting technique or back schooling

AR100155

GENERIC RISK ASSESSMENT

Hollow Stem Augering (Execution and Follow-Up)

Items on Issue	Possible Risks	Prevention Measures
Bentonite/cement	Back injury due to package handling	- Use 25 kg packaging - Lifting technique or back schooling
Bentonite/cement	Drying of skin	- Personal protective equipment: gloves, overalls, face protection, safety shoes
Employees of auger operation contractor / ERM Employees	Accident or incident as a result of employees' lack of training	- Allow operation to be carried out by trained personnel
Image (investigators scare off clients by wearing typical white suit)	Intoxication as a result of not wearing PPE (white tyveks)	- Inform client - Wear tyveks
Work related stress	Accidents or incidents due to stressful activities	- Give realistic task - Plan realistically
General	Third party exposure	- Clear work area
Other		
Other		

Assessment Renewal By/With _____

Date _____

HAZARD AWARENESS/MANAGEMENT CHECKLIST

Working on Undeveloped/Remote/ or Inactive Site

No.	Issues	These Issues Have Been Considered Before Work (Initial each box considered)	What Additional Actions are Necessary Before Beginning Work? (State Them)
Personnel Management			
1	Has an effort been made to secure at least a two-person team for this field work? If only one person is making the field visit has that decision been approved by the project Principal or Partner?		
2	Has someone been designated as the field crew leader to supervise the field activity?		
3	Does the team have instructions on where to park safely and is the most appropriate location for site entry determined?		
4	Has ERM notified the site that an ERM representative will be on site so that entry and security issues are addressed and a site map is provided, if available?		
5	Is there a system in place to ensure that ERM is informed of any unique hazards of this site, to supplement the types of risks mentioned in ERM's Task Hazards Analysis Sheet		
Field Communications			
1	Do team members have a reliable means of contacting another ERM team member in event of an emergency? (such as cell phone, two-way radio)		
2	Is there a system in place to ensure that the team leader contacts each field team member at least at mid-day and communicate that all team members have safely left the site at the end of the day?		
3	Has a plan been developed on how to address or deal with any unauthorized people encountered on or near the site?		

Working on Undeveloped/Remote/ or Inactive Site

No.	Issues	These Issues Have Been Considered Before Work (Initial each box considered)	What Additional Actions are Necessary Before Beginning Work? (State Them)
Field Safety			
1	Are the required PPE determined and their use planned? At least: <ul style="list-style-type: none"> - Sturdy Work Boot (Steel toed shoes if crushing or puncture wound potential) - Long pants; (Long sleeves to combat poison ivy or pest bite/ sunburn) - Safety glasses (if potential for physical damage or windblown particulate); - Chemical resistant gloves if specifically required - Hard hat, when working on an industrial site or if any head injury from falling objects or other agents is possible. 		
2	Is there a process in place to ensure awareness of need for foul weather gear?		
3	Have plans been made to have extra water available while on site?		
4	Have you considered and addressed the need for a first aid kit? If the site is remote from available medical support, then a first aid kit should be taken in the car or personal backpack.		
5	Is the team aware of any local plants or pests that could carry disease or cause harm? Have applicable repellents, netting, clothing, and other protections been acquired?		
6	If a field person is allergic to any natural agents does he/she have the appropriate antidotes with them?		
7	Has the team addressed the need for periodic clothing and body inspection to note the presence of poisonous or disease-bearing insects, worms, etc.		

Appendix C
Health and Safety Plan

Health & Safety Plan

68th Street Landfill Site Rosedale, Maryland

Prepared for:
68th Street Sites Coalition
Lathrop & Gage L.C.
2345 Grand Boulevard
Suite 2800
Kansas City, Missouri 64108

Prepared by:
Environmental Resources Management, Inc.
200 Harry S Truman Parkway
Suite 400
Annapolis, Maryland 21401

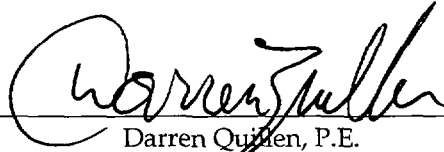
June 18, 2007

Health & Safety Plan

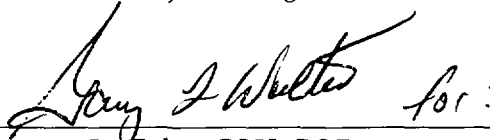
68th Street Landfill Site
Rosedale, Maryland

June 18, 2007

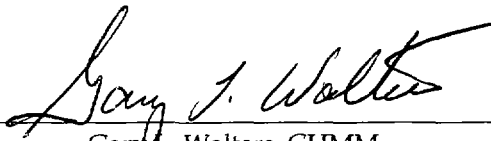
ERM Project No.: 0049608



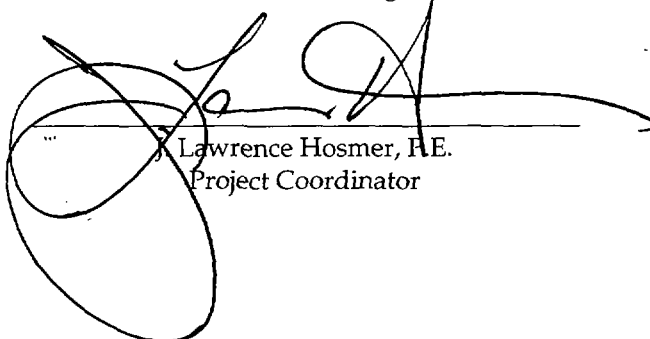
Darren Quillen, P.E.
Project Manager

 for:

Joe Baker, C.I.H., C.S.P.
Corporate Director of Health and Safety



Gary L. Walters, CHMM
Partner-in-Charge



Lawrence Hosmer, P.E.
Project Coordinator

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Emergency Numbers

Ambulance	911
Physician	911
Johns Hopkins Bayview Medical Center	410-550-0100
Fire Department	911
Police	911
Baltimore County EMS	410-887-4860
USEPA	800-424-8802
Chemtrec	800-424-9300
USCG National Response Center	800-424-8802
National Poison Control Center	404-588-4400
CSX Public Safety Coordination Center (for any CSX rail-related emergency)	800-232-0144 (at-grade Crossing #141518W)

1.0

INTRODUCTION

1.1

PURPOSE

The 68th Street Sites Coalition (Coalition) is conducting a Remedial Investigation/ Feasibility Study (RI/FS) of the 68th Street Landfill Site (Site) located in Rosedale, Baltimore County, Maryland. This Health and Safety Plan (HASP) is a project control document prepared to support implementation of the Statement of Work (SOW) included as Appendix C to the Administrative Settlement Agreement and Order on Consent (ASAOC), as specified in the Site Wide Program Management Plan (SWPMP) dated November 15, 2006. The HASP is one component of the Site-Wide Work Plan (SWWP) which will be applied to all field activities conducted at the Site. Specifically, this Site-wide HASP provides baseline health and safety practices for all staff, contractors and visitors performing any on-Site activities at the Site. The Plan also applies to those areas immediately adjacent to and associated with the Site that are part of the Remedial Investigation and Feasibility Study (RI/FS) study area (see Figure 1). Entities comprising and contracted to the Coalition will develop their own action-specific Health and Safety Plan for their employees who address specific activities, but concurrently must also meet the minimum general requirements specified in this Site-Wide Health and Safety Plan. All contractor action-specific HASPs (termed "CHASPs") will provide specific health and safety requirements that are pertinent to their own anticipated activities. Regulatory agency employees, visitors and others not under the direct control of the Coalition are subject to the general requirements presented herein, but may or may not prepare separate CHASPs for their participation independent of the project team. In the event that a conflict in procedures or requirements exists between this HASP and any individual action-specific CHASPs, the procedures or requirements that are most protective will be applied.

The procedures set forth in this plan are designed to reduce the risk of exposure to chemical, physical, and environmental hazards associated with the anticipated activities to be conducted at the Site, as discussed in Section 1.3. The procedures contained herein were developed in accordance with the provisions of 29 CFR 1910.120 ("Hazardous Waste Operations and Emergency Response"); this HASP incorporates the applicable sections of 29 CFR 1910 and 1926 by reference, and all operations will comply with those standards. Contractors working at the Site will be required to follow all federal, state, and local laws and regulations, thereby incorporating these standards as well.

All on-Site personnel are responsible for compliance with the provisions of this HASP, at a minimum. Failure to do so may result in immediate dismissal and removal from the Site. Further, the "Site", for purposes of this HASP, is defined as all those portions of the study area which are currently under investigation, regardless of whether they are within the boundaries of the Site as defined by the United States Environmental Protection Agency (USEPA) in the ASAOC. Also, the HASP procedures and requirements specified herein are applicable to all actions, whether related to Site investigation and remediation or not.

Lastly, this HASP is intended to be a "living" document; as activities change or results are obtained from the investigations, modifications may be required which will dictate that this HASP be revised or amended. The most current HASP will be maintained at the Site during any field activities and will be applicable; each document is dated in the lower right hand corner of each page to assure that the most current version is implemented.

1.2

SITE INFORMATION

Site Name and Address

68th Street Landfill Site
Rosedale, Maryland 21237

Site Location

The Site, as delineated by the USEPA, is an aggregation of the waste disposal areas for five (5) former landfills (designated as "Source Areas") separated and/or bounded by adjoining wetland areas and surface waters. This broader "study area" is being addressed by the RI/FS and represents the effective limits of this HASP. The Site is located immediately south of the Rosedale Industrial Park in Rosedale, Maryland, in the Baltimore East Quadrangle of the United States Geological Survey (USGS) 7.5 minute map at a latitude of 39°17'30"N and a longitude of 76°31'60"W.

The aggregated waste disposal areas which comprise the USEPA-delineated Site occupy approximately 150 acres; the broader study area is bounded by Herring Run to the west, the CSX rail lines to the north, Herring Run and the Norfolk and Southern/Amtrak rail lines to the south, and Redhouse Run and Herring Run to the east. The study area consists of approximately 270 acres which is predominately heavily vegetated with a surrounding land use of industrial properties to the north, south, and west and residential properties to the east (Rosedale Terrace) and northwest (Maryland Manor). Access to the Site for the proposed investigation activities is as follows (Figure 2).

- Primary access to the southern portion of the Site (MA-A and MA-B) is gained from Quad Avenue.
- Access to the northeastern part of the Site (MA-C and MA-D) is gained from the southern end of 68th Street.
- The Island Landfill (i.e., Source Area 3) is accessible only by crossing Herring Run; either fording the stream at low tide from the north or south or via boat. However, to facilitate repair of the Baltimore County (County) sanitary sewer force main which crosses Herring Run elevated at two locations, the County has permitted and constructed a 12-foot wide temporary stream crossing between MA-C and the Island Landfill. Although the use of heavy equipment is not anticipated for the investigation of the Island Landfill, the stream crossing is capable of supporting construction-type vehicles. Coordination with Baltimore County may result in an ability to use this temporary stream crossing as this provides the safest means of access to the area.
- Access is also restricted on the western portion of the Site, MA-E. Vehicular access to MA-E is via the Moravia Road off-ramp of Interstate 95; however, steep slopes limit this access once in the area. MA-E can also be accessed by personnel fording Moores Run during low-flow conditions from the north, or the construction of temporary stream crossings such as that currently employed to access the Island Landfill, or bridging. If necessary, additional access routes may be supplemented by clearing new trails between MA-D and MA-E.

Strict adherence to health and safety procedures for crossing the waterways and railways, and exiting Interstate 95 will be followed during ingress to and egress from the Site. These procedures are described in subsequent Sections of this Health and Safety Plan.

Primary Contacts

Contacts with respect to health and safety issues at the Site should be made to the following individuals, in ascending order:

Individual	Assignment	Telephone Number
Nathaniel Warner	Field Task Manager (FTM)/ Health and Safety Manager (HSM)	
Matthew Erbe, P.G.	RI Task Manager	
Darren Quillen, P.E.	Project Manager	
Environmental Resources Management, Inc.		410-266-0006 410-266-8912 (facsimile)

1.3

SCOPE OF WORK

The conduct of the RI investigations at the Site will require the mobilization/demobilization of personnel and equipment onto the Site, and establishment of Site management facilities as necessary to support the various field activities. The primary activities will include sampling and analysis of the soil, groundwater, surface-water, sediment and air media to accumulate sufficient data to define the nature and extent of Site contamination. Specific data collection efforts are presented in the Field Sampling Plan (FSP), and focus on collecting those data necessary to fill the data gaps identified in the SWPMP (Section 3.0). The sampling objective will be accomplished by implementing the scope presented in the overall SWWP using the methods and procedures described in the FSP while conforming to the requirements of this HASP and the accompanying QAPP.

It should be noted that the requirements of this HASP equally apply to work performed by other parties at the Site, including the USEPA and the Maryland Department of the Environment (MDE), and their contractors, and all other third parties. The following discussion provides a summary of anticipated work activities to be performed at the Site.

1.3.1

Non-intrusive Activities

Topographic Survey, Habitat Survey, and Geophysical Survey

Visual reconnaissance, inspections, Site visits and similar activities that do not disturb the ground surface will be conducted throughout the course of the project. Specific requirements will include overall surface feature mapping, the delineation of wetlands and other habitats, land surveying to document the wetlands delineated and Site topography, and geophysical surveys. These activities are non-intrusive but will require traversing the surface of the Site.

1.3.2

Intrusive Activities

Vegetation Clearance and Access

The majority of the Site is currently heavily vegetated; access to sampling locations with large equipment will require the cutting, removal, and disposal of vegetation and surface debris. Road clearing may be required. Earthmoving and other construction equipment, chain saws and similar equipment/vehicles will be used on the Site to clear vegetation and establish pathways to the sampling locations.

Monitoring Well, Test Pit, and Soil Boring Installations

Monitoring wells, piezometers, test pits, and soil borings will be installed during the investigation using drilling and excavating equipment. Soil borings will be advanced using direct push (i.e., Geoprobe™), hollow-stem augers, and/or mud-rotary drilling methods. Test pits/trenches will be installed using excavators and backhoes.

Sampling of Soils, Sediment, Soil-Gas, Surface Water, Groundwater, Biota

Sampling of all media available at the Site will be conducted, including groundwater, surface water and leachate seeps for various aqueous parameters; soil samples for environmental and geotechnical parameters; and biological (i.e., fish tissue and invertebrates), sediment, and soil-gas samples.

1.4

PERSONNEL ACKNOWLEDGEMENT

All on-Site personnel will be required to have read and understand the general requirements of this HASP as well as the applicable CHASP prior to entering the Site. The Field Task Manager or his designee will present a standardized briefing on Site Safety and the HASP to all visitors authorized access prior to their arrival on-Site. Personnel will be required to acknowledge that they have received the briefing and read the HASP/CHASP by signing the form presented in Attachment A. Unauthorized personnel and trespassers will enter the Site at their risk and responsibility.

2.0 PROJECT /ORGANIZATIONAL STRUCTURE

2.1 PROJECT COORDINATOR

Mr. J. Lawrence Hosmer, P.E. will serve as the Project Coordinator. As Project Coordinator, he will be responsible for all activities conducted at the Site under the ASAOC on behalf of the Coalition. Mr. Hosmer will be the primary contact with the USEPA Remedial Project Manager, Mr. Christopher J. Corbett.

2.2 PROJECT MANAGER

Mr. Darren Quillen, P.E. will serve as the Project Manager. As Project Manager, he is responsible for assigning and managing the resources applied to the project, coordinating staff and work activities, reviewing quality and performance for each task, and ensuring that the technical, financial, and scheduling aspects of the project meet the stated objectives. The Project Manager also serves as a point-of-contact and control for planning and implementing work tasks, and reports to the Project Coordinator.

2.3 HEALTH AND SAFETY MANAGER

Mr. Nathaniel Warner, P.G. will serve jointly as the Field Task Manager (FTM) and the Health and Safety Manager (HSM). As the FTM, Mr. Warner is responsible for overseeing the field activities and acting as the on-Site HSM. His duties will include scheduling and conducting health and safety briefings, periodic audits, and as a health and safety resource during the field activities. Mr. Warner will work with the various contractor Site Safety Officers (SSO) and Site managers to manage health and safety issues on-Site; he will provide oversight, but not direct control over health and safety matters for contractor activities. As the HSM, he will review and accept the CHASPs for conformance with the HASP minimum standards. In this role, Mr. Warner will report to the Corporate Health and Safety Officer, as well as the RI Task Manager.

2.4

FIELD PERSONNEL

All sampling activities will be conducted by experienced environmental, hydrogeologic, or geotechnical field personnel. Their responsibilities will include the prosecution of the work individually and in teams in compliance with the requirements of the HASP. The field personnel will be organized by teams which report to the FTM.

2.5

CONTRACTOR ORGANIZATIONAL STRUCTURE

Contractors, as part of their CHASP, must include their organizational structure with the name of the individual responsible for all aspects of the Site work. The Contractor Site manager/superintendent is ultimately responsible for the health and safety of his employees; however, contractors must also identify a trained, qualified and dedicated Site Safety Officer (SSO) whose sole duty is to support health and safety activities at the Site.

The SSO will be responsible for ensuring that the requirements of the CHASP are properly implemented, and that the CHASP is at all times in conformance with the overall Site-wide HASP. An Alternate Site Safety Officer (ASSO) may be designated to support the SSO. The contractor SSO, in conjunction with their Site manager and ASSO, will be responsible for:

- Field implementation, evaluation, and any necessary field modifications of their CHASP;
- Maintaining adequate supplies of all personal protective equipment as well as calibration and maintenance of all monitoring instruments; and,
- Suspending activities at the Site that are not in conformance with either their CHASP or the Site-wide HASP.

While it is recognized that the HSM, contractor Site managers/superintendents, and SSOs are key members of the safety team at the Site, diligence on the part of all employees, including participation, understanding and buy-in of the safety program, are critical. To that end, the use of front-line supervision, such as the team leaders or foremen, should be the focal point for the field safety effort.

3.0 *SITE HAZARDS*

3.1 *CHEMICAL HAZARDS*

Chemical substances that pose a potential health/safety hazard to on-Site personnel include:

- Heavy metals (e.g., lead, arsenic, etc.);
- Organic contaminants, including PCBs and Polycyclic Aromatic Hydrocarbons (PAHs);
- Methane gas; and,
- Volatile Organic Compounds (VOCs).

Table 1 presents health hazard information for the primary materials anticipated at the Site; the table is not, however, inclusive of all possible contaminants of concern. This listing outlines the chemical and physical properties, and hazardous characteristics of each substance. At a minimum, contractors will consult this information when developing their CHASP and performing the Task Hazard Analysis. Additionally, this information will be consulted to establish work practices, engineering controls, administrative controls and proper personal protection equipment (PPE) selection to minimize employee exposure.

3.1.1 *Chemical Exposure Monitoring*

The symptoms of chemical exposure vary depending on the chemical and the extent of exposure. Table 1 provides the routes of exposure and symptoms of acute exposure for specific chemicals that may be encountered at the Site. General symptoms that are readily identified, and that may indicate the initial stages of exposure include:

- headaches, dizziness, and/or blurred vision;
- nausea and/or cramps;
- irritation of eyes, skin, or respiratory tract;
- changes in complexion/skin discoloration;
- changes in coordination, speech, and/or demeanor; and,
- excessive salivation and pupillary response.

Field personnel will constantly be aware of the need to observe each other for signs of toxic exposure. Any detected effects of toxic exposure will be reported to the respective SSO and the HSM immediately.

3.2

PHYSICAL HAZARDS

It is recognized that the Site includes dense vegetation, significant slopes and changes in terrain, major flowing waterways and ponds, exposed waste debris in the Source Areas, and highway, railroad and pipe crossings. Specific physical/safety hazards that may be encountered by personnel during Site operations include:

- Heavy equipment operations and vehicular traffic;
- Railroad and highway crossings;
- Back strain/heavy lifting;
- Exposure to noise;
- Slip/trip/fall hazards and steep slope surfaces;
- Exposed debris fields containing waste and sharp objects;
- Lack of illumination;
- Surface water, marsh, wetlands; and
- Fires and/or explosions.

The HSM and contractor SSOs will observe the general work practices of their respective on-Site personnel, and enforce safe procedures to minimize physical hazards. Team supervisors will also be responsible for observing and correcting any at-risk behavior as a job function. Adherence to safe work practices will be a requirement for all personnel working at the Site. General safety procedures are provided below.

3.2.1

Heavy Equipment Operations and Vehicular Traffic

Only individuals authorized by their employer may operate vehicles and/or any other equipment at the Site. Contractors will only utilize licensed operators for the types and classes of equipment required for the work. The licenses must be available for review by, and a copy provided to the HSM prior to entering the Site. All operators of heavy equipment (e.g., trucks, excavators, drill rigs, etc.) will be familiar with the requirements for inspection and operation of the equipment to be used. Before equipment is placed into use, it must be inspected by the operator to ensure that it is in safe operating condition. Periodic inspection of equipment must follow the appropriate Occupational Safety and

Health Administration (OSHA) and/or American National Standards Institute (ANSI) guidelines. These guidelines provide for daily, weekly, monthly, and/or annual inspections of equipment components, depending upon type. These inspections will be written and records maintained at the Site. In addition, heavy equipment will be operated in a safe manner, including operating within safe operating speeds and loads, and maintaining visual contact and means of communication between the operator and personnel within the vicinity of the equipment.

All vehicles (e.g., cars, trucks, etc.) must be operated in a safe manner and at speeds below the Site-wide speed limit of 10 miles per hour (mph). In addition, particular care will be exercised when operating near or around visual obstructions, such as building corners, dense tree lines, or large stockpiles, especially in areas where pedestrian traffic is possible. When approaching a "blind corner," vehicle operators must reduce the speed of the vehicle and sound the vehicle horn as necessary to alert any on coming vehicles or pedestrians.

3.2.2 *Railroad and Highway Crossings*

On-site workers will be knowledgeable of the Federal Railroad Administration (FRA) work practices to ensure safe procedures to minimize hazards associated with crossing or working in the vicinity of the CSX railroad tracks. Any work performed within 100 feet of the railroad tracks will be coordinated with the specific railroad; i.e., CSX, Amtrak, or Norfolk Southern. Work within these areas will be compliant with the safety requirements and protocol of the governing railroad. Railroad crossings of personnel and equipment will only take place at approved at-grade crossings (68th Street and CSX railroad intersection).

3.2.3 *Manual Lifting*

Many different types of objects may be handled manually during Site operations. Care will be exercised when lifting and handling heavy or bulky items to avoid back injuries. Employees must follow their employer guidelines and not lift any object that is excessive; multiple employees or mechanical lifting devices will be required for heavy objects.

3.2.4 *Hearing Conservation*

Hearing loss caused by high sound levels is a problem that can be prevented. A hearing conservation program will be implemented at the Site when exposures equal or exceed an 8-hour TWA of 85 dB (A). Caution will be exercised at or around high noise level locations. Engineering controls such as mufflers and baffles will be utilized on equipment when feasible to reduce noise levels.

Personnel working with or around heavy equipment will wear hearing protection, such as E-A-R™ plugs (Noise Reduction Rating [NRR] of 29).

3.2.5 *Slip, Trip, and Fall Hazards*

The Site conditions present numerous slip, trip, and fall hazard areas. In addition, the heavy vegetation in most areas of the Site creates visibility and tripping hazards. The HSM, in conjunction with the contractor SSOs and supervisors will assess each work area to identify the slip, trip, fall, and vegetation hazard areas, and will notify personnel of these areas during the daily safety meeting. In some cases, the areas may be delineated with a warning banner or similar device.

Elevated work where a fall potential exists will be performed using appropriate work platforms with fall protection (i.e., body harness and lifeline). No employee will be exposed to a fall of over 6 feet without being adequately protected; elevated work must comply with the provisions of 29 CFR 1926, Subpart "M."

3.2.6 *Electrical Power*

All electrical equipment exposed to the environment will have a ground fault circuit interrupter as part of the circuit. All such equipment must be suitable and approved for the class of hazard. Applicable OSHA standards for electrical power, 29 CFR 1926, Subpart "K", will apply.

In addition, lockout/tagout procedures will be implemented to assure the safety of personnel during servicing or maintenance of machines and equipment where the unexpected release of stored energy or energizing these machines or equipment could cause employee injury. This includes electrical equipment, as well as other energized equipment, such as gas- or diesel-powered equipment, hydraulic equipment, or mechanical equipment. The lockout/tagout procedures will comply with the requirements established in 29 CFR 1926.417.

3.2.7 *Illumination*

If on-Site activities continue later than dusk or are to be conducted in low light levels, adequate lighting will be provided. Work areas must have adequate lighting for employees to be able to identify hazards. Work will not be started without temporary lighting if it cannot be completed within daylight hours. Illumination levels will comply with 29 CFR 1926.56.

3.2.8 *Debris Fields*

There are many areas on the Site that contain hazards associated with traversing over and/or around partially buried debris fields (resulting in jagged edges, crevices and similar hazards) and debris partially covered with vegetation. Work tasks will include provisions for navigating all such objects and care will be exercised to avoid traversing through any uncovered debris piles, where possible.

3.2.9 *Clearing and Grubbing*

Clearing of portions of the Site will be required to gain access for the sampling program. Clearing consists of the cutting, removal, and disposal of vegetation, and the removal of surface debris. Clearing will be conducted in a manner to prevent damage to adjacent property and vegetation that is to remain in place; only the minimum area of clearing required to facilitate access will be performed.

Before clearing operations begin, a preliminary inspection of the area will be conducted, and Site plans will be reviewed to identify any special provisions that may require attention. If the surface area to be cleared is covered with thick vegetation, the area will be approached from the direction of lesser vegetation inward to identify any hazardous conditions. Once the area has been inspected, clearing may begin.

Tools and/or equipment used for clearing vegetation will be carefully inspected to ensure good working order prior to use. Any equipment found to be deficient will be tagged removed from the Site and replaced.

3.2.10 *Surface Water, Marsh, and Soft Ground*

The Site conditions present numerous surface-water and potential soft ground hazards. In addition, the heavy vegetation in most areas of the Site creates visibility and tripping hazards in the marshy, soft ground areas. The HSM and the contractor SSOs will assess each work area to identify hazards, and will instruct the field personnel of those areas, and the required precautions during the daily safety meeting. In some cases, soft ground areas may be delineated with a warning banner or similar device.

3.2.11 *Fire and Explosive Hazards*

Drilling, well installation, and sampling will require the use of an FID meter and an explosion meter (combination FID/LEL meter or similar) to monitor for fire and explosion hazards during drilling and sampling in areas where methane

and/or other flammable volatile organics may be present. Combustible gas readings will be obtained prior to any welding of casings or when sparking or electrical tools are used.

3.3 ENVIRONMENTAL HAZARDS

Environmental factors that have the potential to adversely affect human health during the field operations include:

- Cold stress;
- Heat stress;
- Biological hazards, including insects, snakes, poison oak/ivy; and,
- Heavy vegetation.

Each of these hazards is addressed separately below.

3.3.1 Cold Stress

The effects of work in cold environments depend upon factors such as air temperature and wind velocity and direction, duration of exposure, type of protective clothing and equipment, type of work, level of physical effort, and health status of the worker. Cold environments may affect the exposed body surfaces, and in some cases, the deeper body tissues. The most common effects of overexposure to cold environments include hypothermia, frostbite, immersion foot or trench foot:

- Hypothermia results when the body loses heat faster than it can produce it. When this occurs, the blood vessels in the skin constrict to conserve the important vital heat, usually affecting the hands and feet first, and then shivering may occur.
- Frostbite occurs when there is actual freezing of the body tissues, normally when temperatures are below freezing. The skin may first have a prickly or tingling sensation and later become numb with cold; the appearance may range from superficial redness of the skin to white, frozen-like tissues.
- Immersion foot or trench foot occurs as a result of exposure to cool or cold weather and persistent dampness or immersion in water. Immersion foot usually results from prolonged exposure when air temperatures are above freezing, whereas trench foot normally occurs from shorter exposure at temperatures near freezing. The symptoms for

each disorder are similar and include tingling, itching, swelling, pain in some cases or numbness in others, lack of sweating, and blisters.

The intent of all treatment for cold stress is to increase the deep body temperature to 98.6°Fahrenheit (F). Work should be discontinued for any worker with these symptoms; the worker should be brought to a warm area and allowed to gradually warm. For frostbite, the frozen part should be covered with extra clothing or blankets or warmed against your body: do not use direct heat and do not rub the affected area; warming should be rapid but gentle.

All workers will be trained in the recognition of the symptoms and treatment of cold stress disorders. Further, these hazards will be discussed during daily safety meetings when relevant.

3.3.2 *Heat Stress*

Heat stress occurs when the body's physiological process fails to maintain a normal body temperature because of excessive heat. Heat stress can cause a number of physical reactions ranging from mild to fatal, and may occur at any time when work is being performed at elevated temperatures. Wearing chemical protective clothing increases the risk of heat stress.

Site workers must learn to recognize and treat the various forms of heat stress. The best approach is prevention (e.g., increase water intake, utilize a cool/shaded area for breaks, establish work-rest schedules) and recognition of the early signs of heat stress. Some of the most common heat stress reactions are discussed below:

- Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of the body heat regulating mechanisms (i.e., sweating). The symptoms of heat stroke include: red, hot, dry skin; nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rate; and unconsciousness or coma. The primary treatment for heat stroke is to cool the victim quickly. If the body temperature is not brought down rapidly, permanent brain damage or death will result.
- Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. The condition is much less dangerous than heat stroke, but nonetheless must be treated. Symptoms of heat exhaustion include: pale, clammy moist skin; profuse perspiration; and extreme weakness. The primary treatment for heat exhaustion is to remove the individual to a cool location, loosen clothing, provide water, and allow rest.

- Heat cramps are caused by perspiration that is not balanced by adequate fluid intake. Heat cramps are often the first sign of a condition that can lead to heat stroke. Symptoms of heat cramps include acute painful spasms of voluntary muscles (e.g., abdomen and extremities). The primary treatment for heat cramps is to remove the individual to a cool location, loosen clothing, provide water, and allow rest.

All workers will be trained in the recognition of the symptoms and the treatment of heat stress disorders. Further, these hazards will be discussed during daily safety meetings when relevant.

3.3.3 *Biological Hazards*

Biological hazards that may be encountered during Site activities include bites by ticks and other insects (e.g., wasps, mosquitoes), poisonous snakes, and contact with poisonous plants (e.g., poison ivy, poison oak). Ticks are transmitters of many different diseases, including Rocky Mountain spotted fever, Q fever, tularemia, Colorado tick fever, and Lyme disease. It is suggested that all workers check themselves periodically for ticks while working on the Site, and upon exiting. When working in tall grass or brush areas, workers will wear long trousers and apply insect repellent to pant legs and socks to deter ticks and other insects. All field personnel will have access to soap and water to clean any skin that may have been exposed to poison ivy/poison oak prior to exiting the Site.

3.3.4 *Heavy Vegetation*

In areas of heavy vegetation, extreme care will be exercised, including:

- Working in pairs;
- Knowledge of the conditions in front before stepping;
- Looking for potential trip hazards on irregularly shaped and surfaced ground;
- Avoiding areas with excessive surface water and groundwater; and,
- Exiting the area by the same path used to enter in thick vegetation.

TASK-SPECIFIC HAZARDS AND CONTROL STRATEGIES

The HSM and each contractor SSO will perform a Task Hazard Analysis (THA) as part of the planning and preparation for any significant work activity. The THA will be used to identify health and safety hazard concerns, and the appropriate work practices and/or PPE required to minimize potential exposure. The action-specific CHASPs will include a Task Hazard Analysis along with recommendations and requirements. Employees will be trained on the THA to understand the hazards and methods of controlling each. During mobilization, the field team can quickly review the hazards and control strategies by locating the task or activity to be performed on the table. Hazards that are common to all activities performed at the Site will be listed first. The hazards listed in the THA for a particular task or activity include only the common hazards; prior to initiating any new field activity or when there is a change in Site conditions, an additional THA will be completed. A copy of the THA form and the generic hazard assessments for the Site activities are provided in Attachment B.

4.0

TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

4.1

OSHA TRAINING

Prior to initiating any intrusive work activities in the exclusion zone, all Site personnel will have completed an OSHA 40-hour and annual 8-hour refresher course in the "Hazardous Worker Training Program" to comply with 29 CFR 1910.120(e). Non-intrusive work activities will not require this level of training, but conformance with all other aspects of this HASP will nevertheless be required. Site personnel involved in sampling and other potentially intrusive activities will also be included in a medical monitoring program and have a current medical clearance for work fitness from an examining physician. The work clearance must include fitness for respirator use and successfully passing a qualitative or quantitative "fit test". Medical clearance and training records will be retained at the Site. Beyond the basic and refresher training for hazardous waste management, Site personnel engaged in work activities that include materials handling, staging, and decontamination will be required to have supplemental training to comply with the Lead Standard (29 CFR 1926.62) and the Asbestos Standard (29 CFR 1926.1101), as appropriate.

Contractors will be responsible for ensuring that their workers are additionally trained for the specific types of work they perform. Refresher or supplemental training must be given anytime a new hazard or process is introduced, and the training documented and records maintained by the contractor on Site. OSHA additionally stipulates supplemental training requirements for various individuals with unique skills, such as competent persons for scaffold builders and excavations, equipment operators, wearers of PPE, etc. The appropriate training for these activities will be applied.

4.2

SUBSURFACE CLEARANCE

Subsurface clearance (SSC) to reduce the likelihood of workers striking subsurface structures during ground disturbance activities will be instituted. The SSC requirements will be met by implementing all procedures presented in this HASP, the field checklist, and documented training. Information gathered in preparation for ground disturbance will be maintained, and risk management steps and communications with third parties will be documented. All workers involved with ground disturbance will undergo both classroom and field training on the SSC requirements before their initial Site work involving drilling,

trenching or other subsurface disturbance. Trained personnel will be on-site at all times when intrusive work is being performed. On-Site ground disturbance can proceed after the subsurface clearance preparation tasks have been completed and each disturbance location is cleared.

4.3

DAILY REVIEW

Daily safety meetings are a requirement, held prior to starting work each day; attendance will be documented. These meetings will be used to provide information regarding the work to be performed that day, the hazards that could be encountered, and the steps that will be taken to minimize any potential risks. PPE requirements will be reviewed as part of the meeting. Other safety related information, such as emergency procedures, first-aid reminders, and Site safety policies, may also be addressed.

5.0

SITE CONTROL

This section provides a summary of the procedures and requirements for maintaining access control and security on the Site. Currently the Site is readily accessed by trespassers since there is no Site-wide fencing or other perimeter controls. The active rail lines along the northern and southern borders, and the various streams dissecting the Site do, however, restrict vehicular, if not pedestrian access. Site control gained through the establishment of work zones is provided in Section 6.0.

5.1

SITE ENTRY

Prior to any Site visit, the Project Manager must be notified to request approval of the visitor and the purpose of the visit. The Project Manager will, in turn, notify the FTM and the HSM.

All personnel, contractors and visitors will enter the Site through the designated Quad Avenue or 68th Street entrances, both accessible from U.S. Route 40 (Pulaski Highway), unless otherwise directed by the Project Manager or HSM. Visitors must report immediately to the FTM on Site, identify themselves and state the purpose of their visit. The FTM will then notify the appropriate on-Site contact and the HSM; the HSM will assure that the visitors are properly briefed on the HASP requirements and assure that the visitor(s) are aware of the potential hazards. Once access to the Site has been granted, visitors must sign the Daily Sign In/Out Log maintained to be maintained by the HSM. Visitors will be escorted by their contact and will only enter authorized areas.

Access to the Site will be allowed between 6:00 a.m. and 6:00 p.m. during normal workdays, unless the Project Manager grants prior approval for alternative times.

Since the Site is transected by streams, roads, and railroads, access to specific work areas may require routes other than Quad Avenue or 68th Street. Safety hazards may exist along potential access routes. Table 2 presents the potential access routes, safety considerations, and precautions to consider for Site and work area ingress and egress.

5.2

SECURITY

No uniformed security will be present at the Site. Therefore individual contractors are responsible for:

- Controlling access to the Site;
- Maintaining Site emergency radio/telephone communication; and,
- Notifying the FTM, or designee, Baltimore County/City Police, and/or Baltimore Fire Department, as appropriate, of Site emergencies, trespassers, or unusual situations. This is critical since each contractor on-Site will be responsible for their property, securing tools and equipment, and removing keys from equipment at the end of the workday.

5.3

SITE COMMUNICATIONS

Site communications will be maintained using verbal communication, hand signals, air horns, cellular telephones, and two-way radio systems.

Communications between field teams and contact with personnel in the support zone are essential in the both the heavily vegetated and wetland areas of the Site.

5.4

AUTHORIZATION TO ENTER

Only personnel who have completed a 40-hour hazardous waste operations training course, as defined under OSHA Regulation 29 CFR 1910.120, have completed their 40-hour training or refresher training within the past year, and have been certified as fit for hazardous waste operations by a physician within the past year will be allowed within an exclusion zone. A training and medical file will be established on Site by each contractor which is accessible for review. The 40-hour training, update, and specialty training (first-aid/cardiopulmonary resuscitation [CPR]) certificates, vehicle operating licenses, as well as the current annual medical clearance for all field personnel will be maintained within these files. These files will be subject to audit by the Coalition and the USEPA.

5.5

HAZARD BRIEFING

Prior to working on the Site, all personnel will be provided a Site hazard briefing which will review this Site-wide HASP. All persons on the Site, including visitors, must document their attendance at this meeting by signing a Site-specific form. Contractor employees will also certify that they have received and understand their employer CHASP.

EMERGENCY ENTRY AND EXIT

The FTM or designee will brief responders that must enter the Site on an emergency basis on the potential hazards. All other personnel will follow the emergency procedures outlined in Section 11.0. Hazardous activities will cease in the event of an emergency and any sources of emissions or releases will be controlled to the extent possible.

Workers exiting the Site because of an emergency will proceed to the closest work area exit/evacuation route with their assigned buddy, and mobilize to the designated safety area associated with the evacuation route. The designated safety areas will be:

1. The end of Quad Avenue to the south of the Site; and,
2. The intersection of 68th Street and the CSX rail lines on the north end of the Site.

Alternate safety areas may be designated if conditions are such that the safety areas or access to the safety areas is not safe. Contractors will perform a roll call to account for all their personnel once they arrive at the safety area. The results of the count will be provided to the HSM. Personnel will remain in the safety area(s) until re-entry is authorized by the HSM, or alternative instructions are provided. Each contractor SSO will be responsible for ensuring that all workers who entered the work area have exited in the event of an emergency.

6.0 WORK ZONES

6.1 GENERAL

Depending on Site activities, work zone operations will include distinct work areas to limit the potential for contamination and the migration of hazardous substances. In addition, air sampling and monitoring programs may be conducted to dictate changes in the delineation of work zones or nature of work activities. The HSM will review air monitoring and sampling results, and perform a Task Hazard Analysis for all hazardous or potentially hazardous Site operations; the HSM will consult with the contractor SSOs as required.

Only authorized personnel who have the appropriate training will be allowed to enter the Exclusion Zones (EZ) and the Contaminant Reduction Zones (CRZ). Unauthorized personnel, untrained personnel, and Site visitors will be required to remain in the Support Zone (SZ) unless authorized otherwise by the HSM.

All on-Site personnel must observe the delineated work zones, including the EZ, CRZ and SZ designated areas, and adhere to the health and safety and PPE requirements specified for each of these work zones. No food or beverages will be permitted in a CRZ or EZ; these are only allowed in designated areas of the SZ. In addition, no tobacco products of any kind or cosmetics will be permitted to be present or used or applied, respectively, in a CRZ or EZ. These are permissible in designated areas of the SZ.

6.1.1 Exclusion Zone

Generally, the exclusion zone (EZ) will be the area in which exposure to potential hazardous substances is a concern (e.g., waste handling, subsurface disturbance and excavation). The extent of the EZ will be determined by the nature and extent of activities, and delineated by the HSM. This designated area prohibits personnel lacking proper training, medical clearance, and PPE from entering. Personnel and equipment in the EZ will be kept to a minimum, consistent with effective Site operations. Contractors will be required to maintain a sign-in sheet for EZ entry and exit.

6.1.2

Contamination Reduction Zone

Contamination reduction zones (CRZ) will be established at a safe distance from activities in the EZ. CRZs will be used to don PPE before entering the EZ, and to remove it after exiting. CRZs will also be used as an area to decontaminate equipment before exiting the EZ and entering the support zone.

6.1.3

Support Zone

Support zones (SZs) will be established as designated areas where unnecessary personnel or unauthorized personnel may remain to observe activities. In general, the SZs will consist of all areas outside of the EZs and CRZs. Any additional support personnel not required in the CRZ or EZ must remain in this area.

7.0 PERSONAL PROTECTIVE EQUIPMENT/LEVEL OF PROTECTION

7.1 SITE OPERATIONS

Personnel involved with the Site operations discussed in Section 1.3 will be required to use appropriate PPE. The level of PPE will be dependent on the type of work and the nature and degree of potential exposure. Each individual will be properly trained in the use of this safety equipment before the start of field activities.

Prior to initiating an activity, the HSM and contractor SSOs will ensure that the selected PPE (e.g., skin protection, respirator cartridges) is protective for all potential contaminants of concern. Safety equipment and protective clothing will be used as directed; all such equipment and clothing must be cleaned and maintained in proper condition by the field personnel. The HSM will monitor the maintenance of personal protective equipment to ensure that proper procedures are followed, as described below.

If the Site presents unknown condition(s) and/or visible contamination (as confirmed by periodic monitoring), an upgrade to a higher level of PPE may be required. If conditions warrant, personnel will exit the operations area immediately, and evaluate the situation before resuming operations.

7.2 RESPIRATORY PROTECTION

Respiratory protection is an integral part of worker health and safety while involved with hazardous materials. In accordance with 29 CFR 1910.134, the Site respiratory protection program will consist of the following:

- All Site personnel who may use respiratory protection will have an assigned respirator.
- All Site personnel who may use respiratory protection will have been fit tested and qualified in the use of a respirator within the prior 12 months.
- All Site personnel who may use respiratory protection must, within the prior 12 months, have been medically certified as being capable of wearing a respirator.
- Only properly cleaned, maintained, Mine Safety and Health Administration (MSHA) and National Institute for Occupational Health and Safety (NIOSH)-approved respirators will be used on this Site.

- If respirators are used, the respirator cartridge will be properly disposed at the end of each work shift. All Site personnel who may use respiratory protection will be clean-shaven; however, mustaches and sideburns are permitted if they do not contact the sealing surface of the respirator.
- Respirators will be inspected, and a positive/negative pressure test performed prior to each use.
- After each use, the respirator will be wiped with a disinfectant cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag.

7.2.1 *Levels of Protection*

Protection levels are determined based upon contaminants present in the work area. In general, the levels of protection and their associated requirements are outlined below:

7.2.1.1 *Level D Protection*

The minimum level of protection that will be required for personnel visiting or working in affected areas of the Site will be Level D, which will be comprised of the equipment listed below. Intrusive and non-intrusive activities are discussed in Section 1.3.

1. Coveralls or long sleeve shirt and long pants, unless otherwise directed.
2. Gloves: Outer nitrile gloves at a minimum for all hazardous or potentially hazardous material handling activities. Inner latex surgical gloves are recommended where practical. Heavy gloves; i.e., leather gloves, are recommended for intrusive or non-intrusive work not requiring the handling of hazardous materials. Heavy gloves will protect the hands from vegetation, falls, and other physical hazards.
3. Safety-toe boots (recommended, but not required for non-intrusive activities).
4. Hard Hat (recommended, but not required for non-intrusive activities).
5. Safety Glasses (recommended, but not required for non-intrusive activities).
6. Options, as required:
 - Disposable outer boots;
 - Hearing protection; and,
 - Hardhat straps.

7.2.1.2 *Modified Level D Protection*

Personnel who will be working in areas with potential skin contamination will use Modified Level D protection. The following equipment will comprise Modified Level D:

1. All requirements for Level D.
2. Work clothing as prescribed by weather.
3. Safety toe boots.
4. Hard-hat.
5. Hooded, regular Tyvek® coveralls or equivalent.
6. Nitrile or work gloves over latex gloves, if required.
7. Safety glasses or goggles.

7.2.1.3 *Level C Protection*

Level C protection will be required when working in areas that pose a respiratory hazard. The HSM and contractor SSOs will be responsible to designate work areas requiring a minimum Level C PPE. The following equipment will be used for Level C protection:

1. Full-face or half-face air purifying respirator equipped with appropriate organic vapor/dust canisters or cartridges.
2. Chemical-resistant clothing such as Tyvek®, Poly-coated Tyvek® or Saranex®. Fire-resistant clothing such as Nomex® may also be necessary during work that poses a potential fire or explosion hazard.
3. Outer nitrile gloves and inner latex surgical gloves.
4. Safety-toe boots with rubber overboots.
5. Hard Hat.
6. Safety Glasses or goggles.
7. Options, as required:
 - Coveralls;
 - Disposable outer boots;
 - Face shield; and,
 - Hearing protection.

7.1.2.4

Level B Protection

Level B protection will be required when working in areas with toxic atmospheres or oxygen deficient atmospheres. The HSM and contractor SSOs will be responsible to designate work areas requiring a minimum Level B PPE. The following equipment will comprise Level B protection:

1. Pressure-demand cascade airline system or other suitable self-contained, pressure-demand breathing apparatus.
2. Chemical-resistant clothing, such as Poly-coated Tyvek® or Saranex®.
3. Outer nitrile and inner latex surgical gloves.
4. Safety-toe boots with rubber overboots.
5. Water-resistant tape over protective clothing as necessary.
6. Hard Hat.
7. Options as required:
 - Coveralls;
 - Escape mask; and,
 - Hearing protection.

7.3

USING PPE

Depending upon the level of protection, specific donning and doffing procedures may or may not be required. Personnel should verify that all PPE is in excellent condition prior to donning. All damaged PPE will not be used and will be disposed of properly. The HSM and contractor SSOs will determine the appropriate doffing procedures in relation to the type of contamination that may be present. Decontamination procedures for Level D will consist of thorough hand washing and proper doffing of PPE. Proper doffing of PPE would, for example, include the removal of inner gloves after decontaminating boots and equipment by turning them inside out. In addition, disposable outer protective garments will be employed to the extent possible to assure that all contaminants remain on the Site. Whenever a worker exits a Level C or higher work Site, the decontamination procedures specified in Section 9.0 of this Site HASP will be followed.

All disposable equipment, garments, and PPE will be bagged in plastic bags, properly labeled for disposal, and stored in a labeled secure area until disposal occurs.

PERSONNEL MONITORING PROGRAM

The goals of the monitoring program are to provide real-time and personal exposure assessment data on potential short-term worker exposure while working on Site, and to ensure that the designated PPE is appropriate. Direct reading and sampling instruments will be used by the HSM and contractor SSOs to monitor hazardous conditions. Workers will be immediately informed of any results indicating possible overexposure, or the need to upgrade the level of PPE.

The selection of methods and equipment for air monitoring will be dependent on the nature of work and associated potential hazards. Direct reading (real-time) monitoring equipment that may be used during various work activities include, but will not be limited to:

- Photoionization Detector (PID);
- Combustible Gas Indicator (CGI);
- Mini-RAM or similar dust monitor; and,
- Dräger Tubes or similar chemical-specific indicator.

The on-Site worker breathing zone action levels for *total VOC* as measured by a PID for exposure durations greater than one minute are:

- 15 parts per million (ppm) - workers use respiratory protection (Level C);
- 75 ppm - increase worker respiratory protection (Level B); and
- 150 ppm - halt site activities, exercise emission controls, and evacuate.

The action levels for the Lower Explosive Limit (LEL) on the CGI in the work zone are:

- 0 – 10%- non flammable, monitor;
- 10 - 25%- monitor and investigate; and
- 25%- halt site activities and evacuate.

The on-Site worker breathing zone action levels for oxygen as measured by a CGI for exposure durations greater than one minute are:

- 23.5 % - workers use respiratory protection (Level B);
- < 19.5% - explosion hazard, monitor and evacuate.

The results of the monitoring will be documented and records maintained at the Site.

DECONTAMINATION PROCEDURES

Decontamination is critical to health and safety at hazardous work sites because it protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment used on the Site. Decontamination also minimizes the transfer of harmful materials into clean areas and helps prevent the mixing of incompatible materials. Decontamination methods physically remove contaminants by one of several processes, inactivate contaminants by chemical detoxification or disinfect/sterilize, or remove contaminants by a combination of physical and chemical means.

Personnel decontamination procedures to be employed at the Site will depend on the level of protection used. However, general decontamination will consist of a "dry decon" using disposable overboots, chemical resistant clothing, and gloves. The procedures will be as follows:

1. Exit the Exclusion Zone.
2. Drop tools and equipment.
3. Cross into Contaminant Reduction Zone.
4. Remove boot covers and discard.
5. Remove outer protective suit and discard.
6. Remove first set of gloves and discard.
7. Remove and wash respirator in decontamination area.
8. Remove second set of sample gloves and discard.
9. Rinse respirator, hand dry, and store properly.
10. Wash hands and arms.

These procedures will be modified to reflect the requirements for different levels of protection. Contaminated PPE will be disposed by accepted methods.

Equipment decontamination will be conducted by scrubbing with a soap and water solution, rinsing with water. Personnel decontaminating equipment will wear proper PPE. All runoff from decontamination will be contained for future treatment/ disposal at a designated on-Site or off-Site facility.

At the completion of major Site activity, Site personnel will establish a clean, orderly Site with waste materials appropriately stored/staged, labeled and secured.

10.0

GENERAL SAFETY

10.1

DAILY SITE SAFETY MEETING

A brief Site safety meeting will be conducted daily or at a frequency appropriate for the scope of work to highlight key issues of concern (e.g., work practices, hazards encountered, proper use of equipment, emergency procedures, and environmental stresses), as well as "lessons learned" from recent experiences through these daily safety meetings. The meetings will be held by the HSM or appropriate contractor SSOs. A log will be maintained to document attendance at these meetings and other safety activities. A copy of the daily sign-in/sign-out sheet will be collected by the HSM daily.

Safety meetings are required for any person that enters the Site, including visitors. Visitors are required to comply with all requirements of the HASP and must don the proper PPE, as presented in Section 7.0.

10.2

HAZARD COMMUNICATION

A written Hazard Communication Program will be established that complies with 29 CFR 1910.1200. New Site personnel will attend a Site safety orientation and training on the Hazard Communication Program conducted by the HSM or appropriate contractor SSO; this training will address the following:

- Requirements contained in the Hazard Communication Standard, 29 CFR 1910.1200;
- Location and availability of the written Hazard Communication Program;
- Reporting authorities for on-Site personnel in the event of an emergency;
- Contaminants present at the Site;
- Physical and health effects of the Site contaminants;
- Methods and observation techniques used to determine the presence or release of Site contaminants;
- Methods to lessen or prevent exposure to Site contaminants through control/work practices and personal protective equipment; and,
- Emergency procedures to follow if exposed to Site contaminants.

The HSM and the contractor SSOs will document the training and maintain records at the Site. In addition, they will assure that all containers on the Site are properly labeled with the contents, stored in a controlled area, and disposed off-Site properly.

10.3 *GENERAL WORK PRACTICE REQUIREMENTS*

The following provides a series of general work practice requirements that must be followed by all on-Site personnel. These are general requirements; the MA-specific work plans and CHASPs developed by the contractors will provide additional requirements specific to the work activities each will perform.

10.3.1 *Confined Space Entry*

A confined space is defined as a space large enough and so configured that a worker can bodily enter, has limited means for entry or exit, and is not designed for continuous worker occupancy. All confined space entries will be performed in accordance with an approved written Confined Space Entry Program developed in accordance with 29 CFR 1910.146.

If confined space entry is anticipated during the course of planned on-Site work, contractors will include a written Confined Space Entry Program in its action-specific HASP. The contractor program must include the classification of permit-required confined spaces, and include the procedures required to determine whether a confined space meets this classification and the personnel authorized to make such determinations. In addition, a contractor Confined Space Entry Program must include procedures and requirements for permit-required confined space, as specified in 29 CFR 1910.146(d), including but not limited to:

- Measures to prevent unauthorized entry;
- Identification and evaluation of hazards;
- Procedures and requirements to ensure safe entry operations (e.g., specify acceptable conditions, isolate the space, control and verification of atmospheric conditions, etc.);
- Specification of entry-necessary equipment (e.g., PPE, ventilation, lighting, rescue equipment, etc.);
- Definition of the roles of confined space personnel (e.g., entrants, attendants, supervisors, etc.) and designation of personnel who will be responsible for these roles; and,

- Written entry permits to verify that all procedures and requirements have been considered and are satisfied prior to entry.

Only personnel properly trained will supervise and participate in confined space entry procedures or serve as standby attendants. All confined spaces will initially be considered permit required; under certain conditions, a space may be reclassified as a non-permit confined space after inspection and monitoring.

10.3.2 *Fire Protection and Hot Work*

Operations involving the potential for fire hazards will be conducted in such a manner as to minimize the risk of fire. Fire extinguishers and non-sparking tools will be used or available as appropriate on all construction equipment and vehicles. Sources of ignition will be removed to the extent possible. When necessary, explosion-proof instruments and/or bonding and grounding techniques will be used to prevent fire or explosion. Real-time air monitoring for combustible gases will be conducted using a combination oxygen/combustible gas monitor, or equivalent inside confined areas.

"Hot work", such as welding and torch cutting, will only be permitted in the SZ. If hot work is anticipated during the course of planned on-Site work, a contractor must include a written hot work permit program in its action-specific HASP, developed in accordance with applicable requirements specified in 29 CFR 190 Subpart Q. At a minimum, contractors will be required to have written procedures to evaluate, monitor, and authorize any hot work. In addition, contractors must ensure that their personnel are properly trained in these procedures, and in the safe operation of the equipment, the safe use of the process, and emergency procedures in the event of a fire.

10.4 *DRUGS/ALCOHOL/SMOKING/FIREARMS*

Medicine and alcohol can increase or exaggerate the effects from exposure to contaminants. Personnel who must use prescribed medicines will inform a qualified physician of the type of work to be performed, the potential for exposure to specific contaminants, and follow the physician guidance for use in this work environment. If the physician does not clear such a worker for activity on the Site, the contractor will promptly replace that worker.

Alcoholic beverage intake is prohibited on the Site and should be minimized off Site. The use of illegal drugs or abuse of controlled or intoxicating substances is prohibited on the Site. Worker(s) identified using alcoholic beverages, illegal drugs, or abusing controlled or other intoxicating substances, or intoxicated while on the Site will be subject to disciplinary action, up to and including

permanent expulsion from the Site. Tobacco smoking is prohibited within the

EZ, CRZ and decontamination areas at all times. Site personnel assigned to work in the EZ and CRZ may only smoke in designated SZ areas during break and lunch periods.

The possession and/or discharge of firearms, explosives and incendiary devices are also prohibited at the Site, unless otherwise required by police, fire or similarly authorized enforcement personnel for public safety purposes.

10.5

BUDDY SYSTEM

All field personnel will operate on the "buddy" system. The "buddy system" is a means of organizing workers into teams in such a manner that each worker in the team is designated to be observed by at least one other team member. A "buddy" is defined as an individual who is in visual contact, and is knowledgeable in the task being performed. If necessary, more remote personnel will be alerted in the area to assure that no worker is performing work alone.

11.0 EMERGENCY PROCEDURES

11.1 EMERGENCY EQUIPMENT

In addition to the PPE used by, or available to Site personnel, emergency equipment will be maintained on the Site, to include an eyewash, first-aid kits, fire extinguishers, and any additional Site-specific equipment as dictated by Site conditions and operations.

11.2 EMERGENCY SIGNALS

A combination of visual and audio signals will be used to notify personnel in the case of an emergency. This may involve cellular telephones, radios, air horns, and/or hand signals. These emergency signals will be discussed at the Site safety meetings and are described in Section 11.4.

11.3 EMERGENCY RESPONSE/CONTINGENCY PLAN

This section describes contingencies and emergency planning procedures to be implemented at the Site. This plan is compatible with City of Baltimore, Baltimore County, State of Maryland and federal disaster and emergency management plans, as appropriate. All on-Site contractors will additionally be responsible for including the provisions of this plan in their action-specific CHASPs to address emergency response.

11.3.1 Pre-Emergency Planning

Workers will be informed of the Site emergency procedures during Site orientation. The HSM and contractor SSO will also review the plan and inform workers of employer-specific requirements. During the daily safety meetings, workers will occasionally be given refresher training on the provisions of the emergency response plan, communication systems, and evacuation routes. The plan will be reviewed and revised, if necessary, on a regular basis by the HSM in conjunction with the contractor SSOs to ensure that the plan is adequate and consistent with current Site conditions.

11.3.2 *Personnel Roles and Lines of Authority*

The FTM/HSM, or his designee has primary responsibility for responding to and correcting emergency situations as they pertain to the Site. This includes instituting appropriate response measures to ensure the safety of Site personnel and the public. Possible actions may involve evacuating personnel from the Site area, and industrial workers and residents in adjoining areas. The FTM/HSM is also responsible for ensuring that corrective measures have been implemented, appropriate authorities notified and follow-up reports completed. An on-Site supervisor may be required to act on the behalf of the FTM/HSM, and may direct responses to any medical emergency; therefore, the FTM/HSM will designate a representative to act in this capacity if the FTM/HSM is unavailable. On-Site contractors will, however, remain responsible for emergencies related to their Site activities or workers, but must immediately notify the FTM/HSM in the event of an emergency.

11.3.3 *Emergency Procedures*

In the event of an emergency that necessitates Site evacuation, the following alarm procedures will be implemented:

- Evacuation alarm notification will be made using three (3) short blasts on air and/or vehicle horns, supplemented by using cellular telephones and hand-held radios. If alternate alarm signals are designated, they will be identified prior to the start of work, and workers will be reminded of the signals during the daily safety meetings.
- All personnel will evacuate upwind of any activities and rally at the designated safety areas to await instructions. Two short blasts on the air and/or vehicle horns (or alternate signal if appropriate) will alert personnel to clear the work areas around powered or moving equipment.
- Personnel will proceed to the closest work area exit/evacuation route with their assigned buddy and mobilize to a designated safety area associated with the evacuation route. The designated safety areas (meeting places) are presented below and on Figure 3:
 1. The end of Quad Avenue to the southern border of the Site; and,
 2. Along East Biddle Street near the intersection between East Biddle Street and 68th Street, located on the northern border of the Site.

Alternate safety areas may be designated by the HSM if conditions are such that the safety areas or access to the safety areas is not safe. Personnel will remain at the safety area(s) until the re-entry alarm is sounded or an authorized individual provides further instructions. A map of the designated safety areas and evacuation routes is provided on Figure 3.

11.3.4 *Emergency Contact/Notification System*

The list of names and telephone numbers for emergency contact personnel is provided below (and on page C-v at the beginning of this document). The emergency contact list will also be posted in any Site trailer(s) or area of congregation at the Site. During an emergency, personnel will receive direction from their employer SSO. The HSM, or designee will notify the appropriate hospital and local, state, or federal agencies as appropriate. The HSM will also notify emergency response organizations, as required, and off Site property owners, if warranted.

Emergency Numbers

Ambulance	911
Johns Hopkins Bayview Medical Center	410-550-0100
Fire Department	911
Police	911
Baltimore County EMS	410-887-4860
USEPA	800-424-8802
Chemtrec	800-424-9300
USCG National Response Center	800-424-8802
National Poison Control Center	404-588-4400
CSX Public Safety Coordination Center (for any CSX rail-related emergency)	800-232-0144 (at-grade Crossing #141518W)

The nearest hospital to the Site is the Johns Hopkins Bayview Medical Center. Directions to this hospital are indicated on the map included as Attachment C.

11.3.5 *Emergency Medical Treatment Procedures*

Any person who becomes ill or injured in the EZ zone must be decontaminated to the maximum extent possible prior to medical treatment. If the injury or illness is minor, full decontamination will be completed and first aid administered prior to transport. If the patient condition is serious, at least partial decontamination will be completed (i.e., complete disrobing of the victim and redressing in clean coveralls or wrapping in a blanket), unless such action would potentially worsen the condition or result in additional injuries. First aid will be administered while awaiting an ambulance or paramedics. All injuries and illnesses must immediately be reported to the HSM.

For contaminant exposure incidents, the HSM, or designee will provide the hospital with information regarding the contaminants that the victim has been exposed to, if necessary.

11.3.6 *Spill or Leaks*

In the event of a spill or leak on-Site, personnel will:

- Locate the source of the spillage and stop the flow if it can be performed safely; if not, identify the material and estimate the quantity;
- Inform the HSM immediately, who will initiate regulatory notification as appropriate; and,
- Begin containment and recovery of the spilled materials.

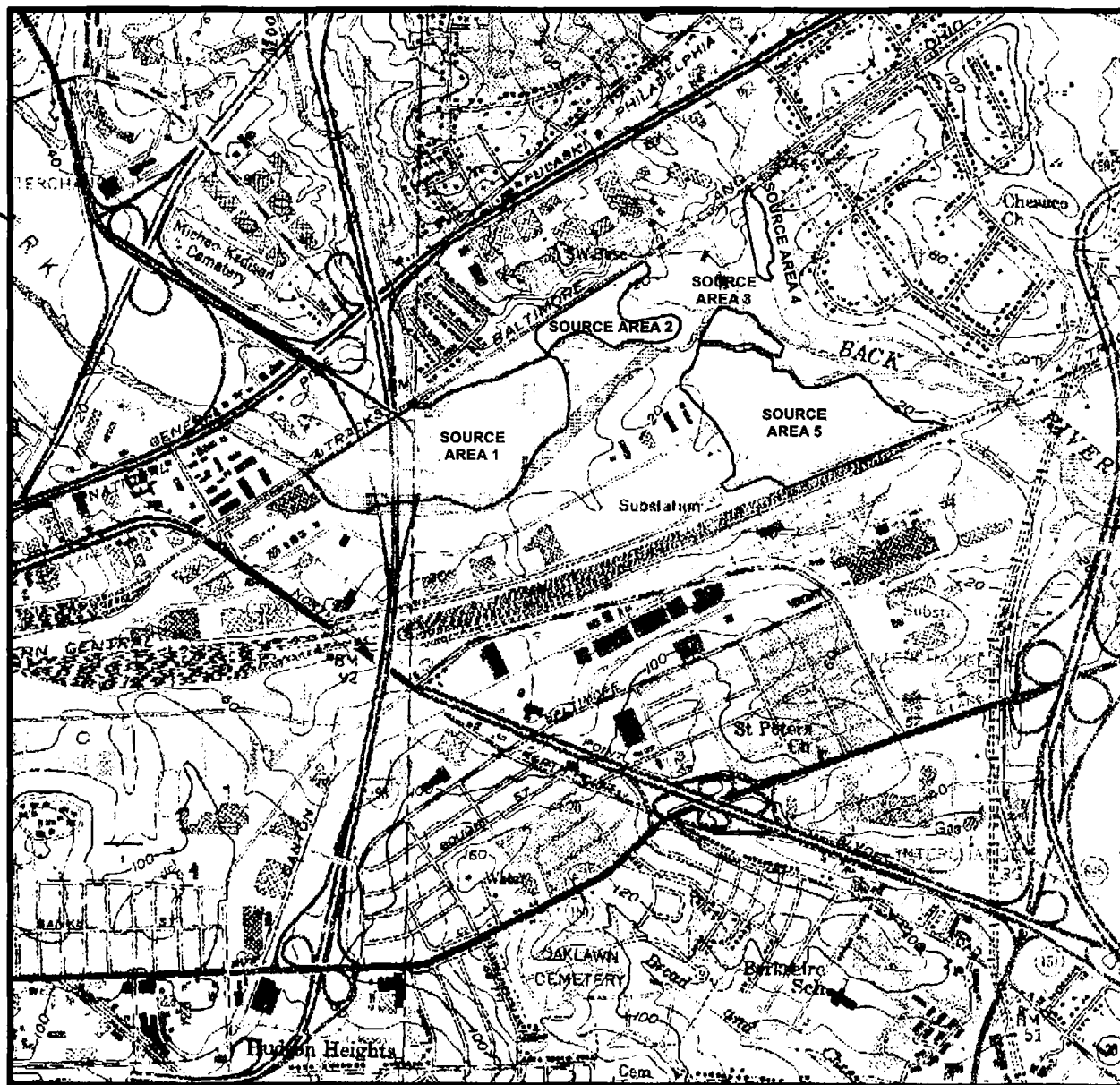
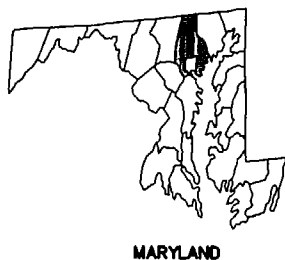
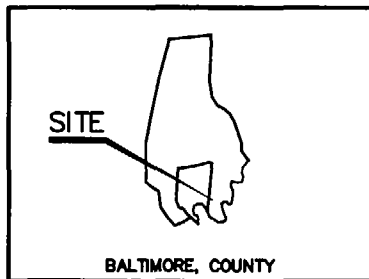
The following information will be documented for any spill:

- Date and time of spill;
- Name of the initial responder, and all other response personnel;
- Type and approximate amount of material spill and area impacted;
- Manner in which the spill was contained;
- Manner in which the spill was removed;
- Manner in which the spill materials were disposed; and,
- Notifications made, including date, time, contact persons and regulatory agencies.

LESSONS LEARNED

As noted within this Health and Safety Plan, there are potential hazards associated with performing RI/FS activities at any site. This plan identifies specific hazards present at the Site and protocols for maintaining a safe work environment. The health and safety of all personnel at the Site is of paramount importance; therefore, in the event of an incident or "near miss" during work activities, it is important that the project team understand the situation and all contributing factors so that they can be avoided in the future. Accordingly, each incident or near miss and corresponding "lessons-learned" will be documented herein to improve safety for future work at the Site. A "Lessons Learned" form is provided in Appendix D. Incidents and "lessons learned" to-date have been annotated in the form; hereafter, the form should be updated, as required, following any Site-related incident or near miss. In addition, the "lessons learned" will be discussed during the daily Safety Meetings.

Figures



ADAPTED FROM USGS
BALTIMORE EAST/1953-PHOTOREVISED/1986/1974



Environmental Resources
Management, Inc.

June 18, 2007



Scale in Feet
1" = 2,000'



FIGURE 1
Site Location Map
68th Street Landfill Site
Rosedale, Maryland



Environmental Resources
Management, Inc.

June 18, 2007



Scale in Feet
1" = 600'

0 300 600
Feet

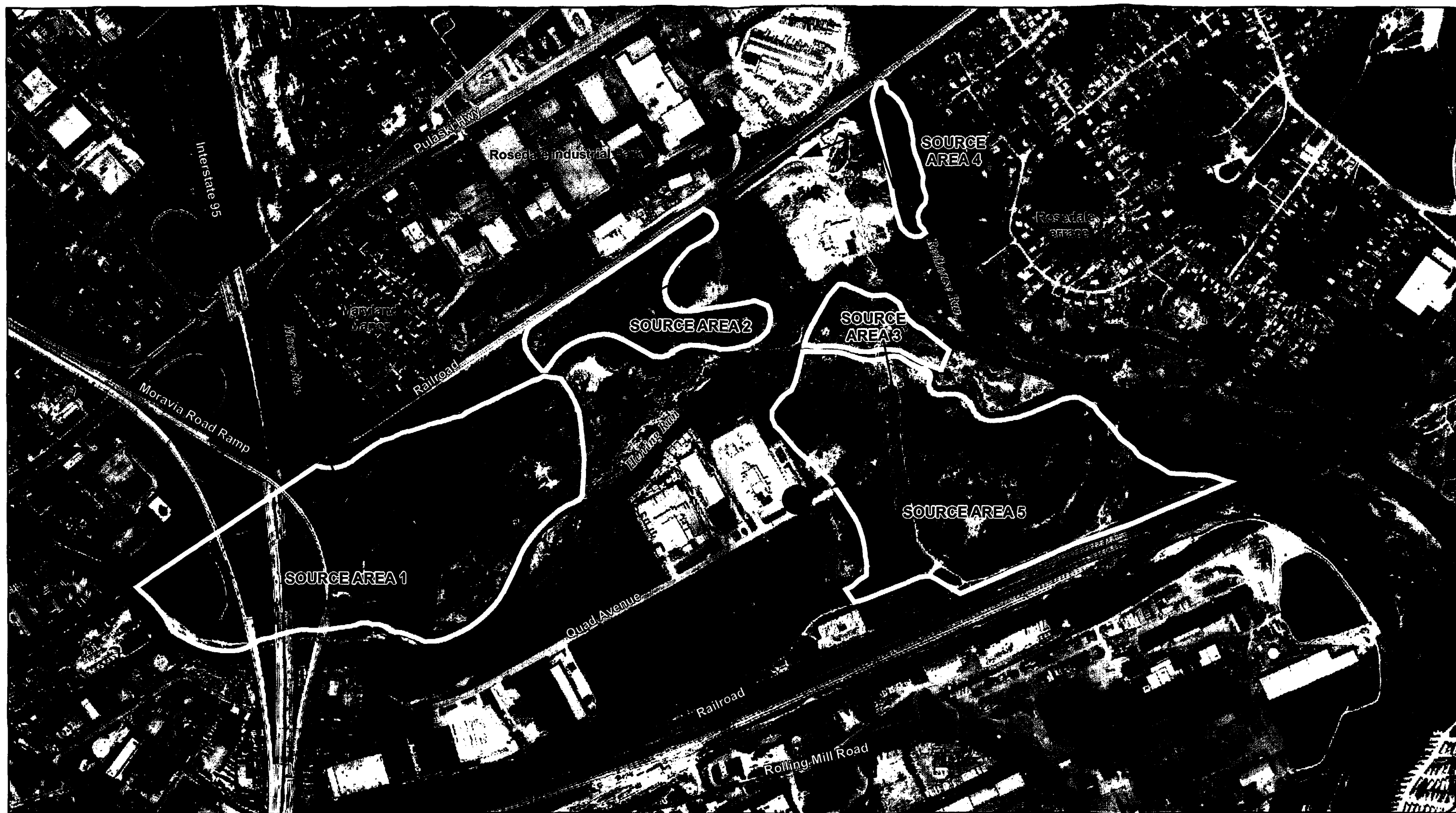
Legend:



USEPA-Defined Source Areas

Existing Developed Land

FIGURE 2
General Plan
68th Street Landfill Site
Rosedale, Maryland



Environmental Resources
Management, Inc.

June 18, 2007



Scale in Feet
1" = 600'

0 300 600
Feet

Legend:

USEPA-Defined Source Areas

● Meeting Place

→ Evacuation Route

Note: Source Area 1 egress shall be
under the railroad and across Moore's Run.

FIGURE 3
Emergency Evacuation Plan
68th Street Landfill Site
Rosedale, Maryland

Tables

Section 3.0 – Site Hazards
Table 1. Health Hazard Information

Contaminant	TLV TWA STEL	IDLH	Characteristics	Routes of Exposure	Symptoms of Acute Exposure	Instruments Used to Monitor Contaminant
Arsenic	0.01 mg/m ³	100 mg/m ³	Grey power, solid yellow crystalline	Inhalation, Ingestion, Contact	severe headache, vertigo, metallic taste in the mouth, nausea and vomiting	Field Test Kits
PAHs	0.1 mg/m ³	100 mg/m ³	solid	Inhalation, Ingestion, Contact	No information on acute exposure to PAHs in humans is available	PID
PCBs	0.5 mg/m ³	Not Listed	Colorless liquid to dark yellow resin	Inhalation, Ingestion, Contact, Absorption	Eye and skin irritation, acne, jaundice	Field test kit
Methane Gas	There are no specific exposure limits for Methane. Methane is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.		Odorless, colorless gas	Inhalation	headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses	Multi-gas Meter
Lead	0.05 mg/m ³	100 mg/m ³	Properties may vary depending on specific compound	Inhalation, Ingestion, Contact	Insomnia, gingival lead line; tremor, anorexia, abdominal pain	Cellulose Ester Filter/ Sample Pump
TCE	100 ppm vapor	1,000 ppm vapor	sweet odor and a sweet, burning taste	Inhalation, Ingestion, Contact	headache, dizziness, vertigo, tremors, nausea and vomiting, irregular heartbeat, fatigue, blurred vision	PID

NOTES:

TVL = Threshold Limit Value
TWA = Time Weighted Average
STEL = Short Term Exposure Limit
IDLH = Immediately Dangerous to Life or Health
PID = Photoionization Detector
ppm = part per million

Section 5. Site Entry
Table 2. Access Points, Safety Hazards and Countermeasures

Management Area (MA)	Potential Access Point	Safety Issues		Countermeasures
		Foot Access	Vehicular Access	
MA A (and adjacent areas of MA F)	Access from Quad Avenue via dirt road	Debris in the roadway and around parking area at the end of Quad Avenue	Debris in the roadway, potholes, standing water	<ul style="list-style-type: none"> Use caution when parking at the end of Quad Ave. Avoid parking too close to debris piles Drive slowly on dirt access roads, look ahead for debris, potholes, water, and debris in roadway
	Access via dirt road from North Point Boulevard	N/A	Uneven and narrow road	Drive slowly on dirt access roads, look ahead for debris and debris in roadway
MA B (and adjacent areas of MA F)	Access from Quad Avenue	Debris in the roadway and around parking area at the end of Quad Avenue	Debris in the roadway, potholes, standing water	<ul style="list-style-type: none"> Use caution when parking at the end of Quad Avenue Avoid parking too close to debris piles Drive slowly on dirt access roads, look ahead for Debris, potholes, water, and debris in roadway
	Access via dirt road from North Point Boulevard	N/A	Uneven and narrow road	Drive slowly on dirt access roads, look ahead for debris and debris in roadway
MA C (and adjacent areas of MA F)	Access via at-grade rail crossing at 68 th St. and Lake Dr.	Trains and vehicle traffic on access road to recycling facility	Trains and vehicle traffic on access road to recycling facility	<ul style="list-style-type: none"> Only cross at established at-grade crossing Use caution crossing railroad Look for oncoming trains and vehicles Do not stop on tracks
MA D (and adjacent areas of MA F)	Access via at-grade rail crossing at 68 th St. and Lake Dr.	Trains and vehicle traffic on access road to recycling facility	Trains and vehicle traffic on access road to recycling facility	<ul style="list-style-type: none"> Only cross at established at-grade crossing Use caution crossing railroad Look for oncoming trains and vehicles Do not stop on tracks
MA E (and adjacent areas of MA F)	I-95/Moravia Road Ramp (dead end on and off ramps)	Parking on shoulder of ramp near transfer lanes	Parking on shoulder of ramp, steep hill off ramp into site	<ul style="list-style-type: none"> Notify MdTA Park as far off of the road as possible Use flashing lights and traffic cones around vehicle Observe traffic behind vehicle before slowing or stopping Use caution when entering and exiting vehicle Inspect steep slopes for hazards (i.e. ice, snow, slick mud, etc.) before attempting to walk or drive on them Inspect road conditions for stability (i.e. ice, snow, slick mud, etc.) before attempting to drive on them Consider alternate route of access or engineered modification to slopes and roadways determined to be too steep to drive on or unstable. Use buddy system

AR-1002-14

Section 5. Site Entry
Table 2. Access Points, Safety Hazards and Countermeasures

Management Area (MA)	Potential Access Point	Safety Issues		Countermeasures
		Foot Access	Vehicular Access	
MA E (and adjacent areas of MA F)	End of E. Biddle St., to Moores Run, under rail overpass, and cross Moores Run via wading	High water in creek Train traffic overhead, slippery rocks and banks, poor water clarity	N/A	<ul style="list-style-type: none"> Inspect creek water levels and current before attempting to cross creek at this point Do not attempt to cross creek during flood events, or when water is too muddy to visually determine water depth Do not cross under rail overpass while trains are moving overhead Limit the amount of equipment transported to area via wading Wear PFD if the water depth is above one foot Use buddy system
MA F Source Area 3	Access Island by cross-over at southern end of MA-C	High water in Creek, fast current, stability of dam	High water in Creek, fast current, stability of dam	<ul style="list-style-type: none"> Notify Baltimore County Do not attempt to cross creek during flood stage Cross slowly In the event of unplanned water contact, communicate to SSO and return to decon area and proceed with decon Use buddy system. The buddy may call for appropriate assistance and should remain on stable ground when assisting personnel out of the water
	Access island by boat crossing Herring Run from north (near Red House Run sewage Pump station)	High water in Creek, fast current, potential for capsize	N/A	<ul style="list-style-type: none"> Wear PFD if the water depth is above one foot Consider a rope system to pull boat across Do not attempt to cross creek during flood stage Do not stand up in boat In the event of unplanned water contact, communicate to SSO and return to decon area and proceed with decon Use buddy system. The buddy may call for appropriate assistance and should remain on stable ground when assisting personnel out of the water
	Walk across concrete pipe located over Herring Run	Balance, slipping, tripping, falling	N/A	<ul style="list-style-type: none"> Cross slowly Keep hands free for balance In the event of unplanned water contact, communicate to SSO and return to decon area and proceed with decon. Use buddy system. The buddy may call for appropriate assistance and should remain on stable ground when assisting personnel out of the water.
	Wade Herring Run in shallow area	High water in Creek, fast current, slippery rocks, poor water clarity, high tide	N/A	<ul style="list-style-type: none"> Inspect creek conditions before attempting to wade across creek Do not attempt to cross during high tide, flood events, or when water is not sufficiently clear to see creek bottom Limit the amount of equipment transported to area via wading Wear PFD if the water depth is above one foot In the event of unplanned water contact, communicate to SSO and return to decon area and proceed with decon Use buddy system

AR-1002-16

Attachments

Attachment A
Personnel Acknowledgement

Personnel Acknowledgement

I have read and fully understand the contents of the Health and Safety Plan, and received the site-specific Health and Safety training.

Printed Name and Company

Date _____

Signature

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Attachment C
Map of Hospital Directions

Map of Hospital Directions

Directions to Johns Hopkins Bayview Medical Center

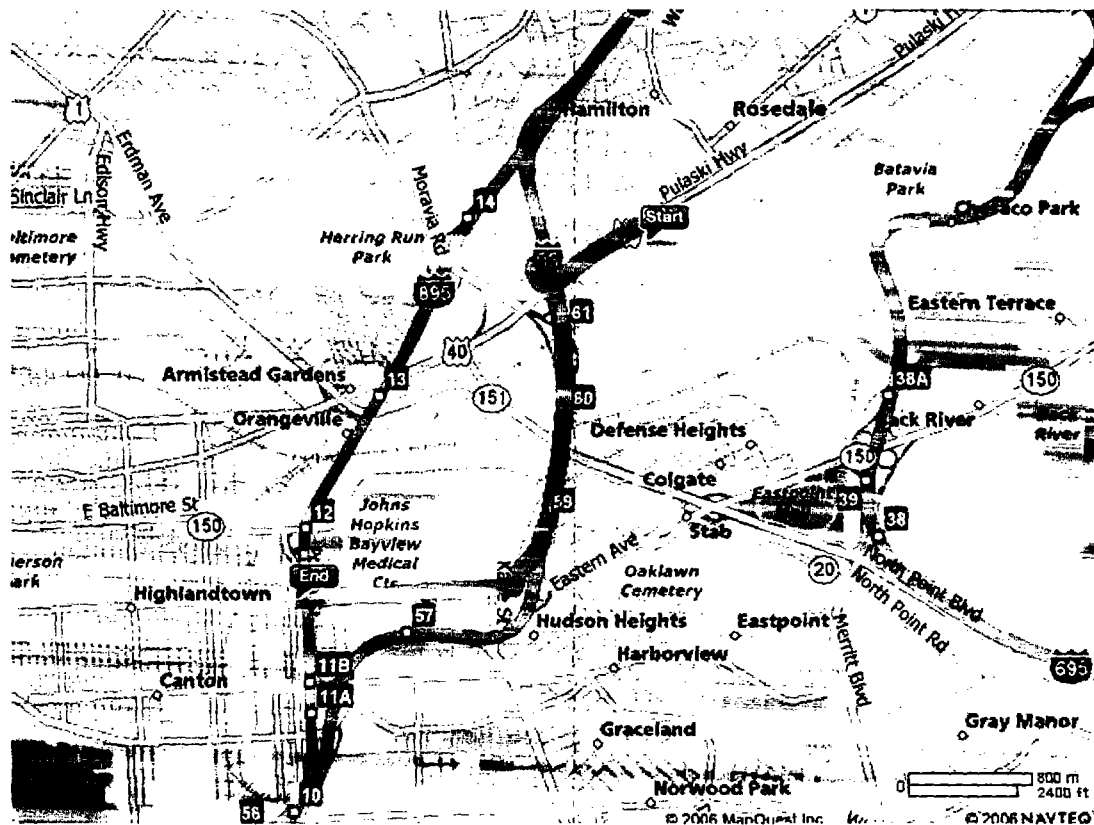
4940 Eastern Avenue

Baltimore, Maryland 21224

Distance from 68th Street Landfill Site: 3.56 Miles; 7 Minutes (both approximate)

Driving Directions:

1. Start out going Northwest on 68th Street toward Pulaski Highway.
2. Turn Left onto Pulaski Highway / US 40 West.
3. Merge onto I-95 South toward Washington.
4. Take the MD-150 West / Eastern Avenue West - Exit 59 toward Highlandtown.
5. Merge onto Eastern Avenue.
6. End at 4940 Eastern Avenue, Baltimore, Maryland 21224.



Attachment D
Lessons Learned

LESSONS LEARNED

	<u>Incident/ Near Miss</u>	<u>Date Occurred</u>	<u>Existing Conditions</u>	<u>Improvements/ Lessons Learned</u>
1.	Hidden open manhole just southeast of where I-95 crosses the northern RR	6/06	An open manhole was hidden by the thick vegetation. The flow of water was heard just prior to stepping in the direction of manhole.	Be aware that the thick vegetation could cover a slip, trip or fall hazard. Walk slowly and carefully in these areas. Listen and look in the area just ahead for obstacles and hazards.
2.	Tripped over roots	2/07	Sporadic vegetation with a root above ground	Tripped due to looking far ahead and not within the immediate walking path. Frequently observe the ground surface within the immediate vicinity.
3.	Almost fell on glass	3/07	Vegetation and glass in the area. Tripped over a root and placed hands to cushion potential fall. Did not fall but realized that a fall would have cut hands on glass.	See No. 2. Wear heavy gloves in areas of thick vegetation and glass.
4.				
5.				
6.				
7.				
8.				

Appendix D
Risk Assessment Work Plan

Risk Assessment Work Plan

68th Street Landfill Site Rosedale, Maryland

Prepared for:
68th Street Sites Coalition
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2345 Grand Boulevard
Suite 2800
Kansas City, Missouri 64108

Prepared by:
Environmental Resources Management, Inc.
200 Harry S Truman Parkway
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Annapolis, Maryland 21401

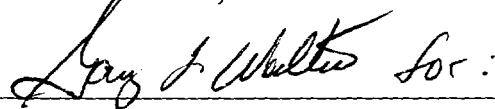
June 18, 2007

Risk Assessment Work Plan

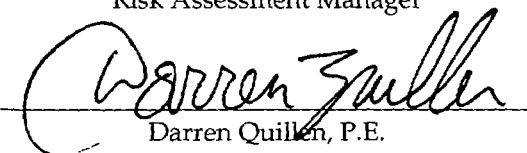
68th Street Landfill Site
Rosedale, Maryland

June 18, 2007

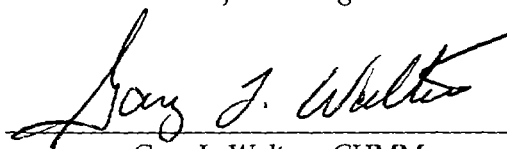
ERM Project No.: 0049608

 for:

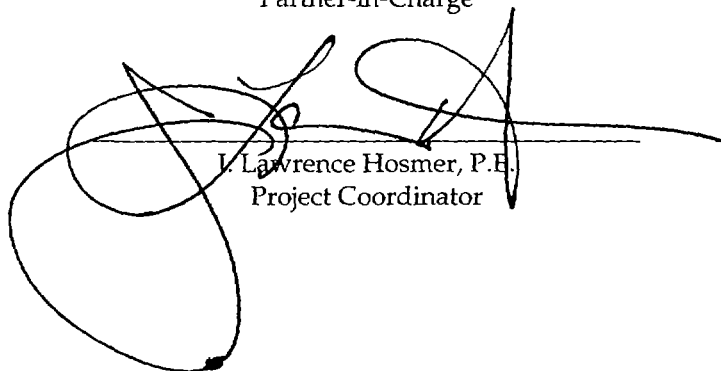
Charles A. Menzie, Ph.D.
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Darren Quillen, P.E.
Project Manager



Gary L. Walters, CHMM
Partner-in-Charge



J. Lawrence Hosmer, P.E.
Project Coordinator

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INTRODUCTION

The 68th Street Sites Coalition (Coalition) is conducting a Remedial Investigation/ Feasibility Study (RI/FS) of the 68th Street Landfill Site (Site) located in Rosedale, Baltimore County, Maryland. This Risk Assessment Work Plan (RAWP) is a project control document prepared to support implementation of the Statement of Work (SOW) included as Appendix C to the Administrative Settlement Agreement and Order on Consent (ASAOC), and specified in the Site Wide Program Management Plan (SWPMP) dated November 15, 2006. The RAWP is one component of the Site-Wide Work Plan (SWWP), and presents an overview of the methodology and procedures that will be used to project potential ecological and human health risks posed by constituents detected at the Site.

A description of the Site background, setting and location, and previous studies conducted for various components of the Site are presented in the SWPMP. The RAWP to be performed at the Site will use the historic data described in the SWPMP and the prior Interim Data Gap Analysis (IDGA) in addition to new data to be generated as described in the Field Sampling Plan (FSP) and associated Quality Assurance Project Plan (QAPP) of the SWWP. The FSP and QAPP provide specific information necessary for field teams to properly conduct data collection and sampling activities in accordance with the SOW requirements; these data must meet acceptable quality standards as outlined in the QAPP, and meet the needs of the follow-on risk assessment and feasibility studies. Management Area-Specific Work Plans, to be prepared at a later date, will provide greater detail with respect to the methods and procedures to be employed for each of the designated areas of the Site. As described in the following sections, the risk assessments will be conducted according to current United States Environmental Protection Agency (USEPA) and USEPA-Region III guidance, which fulfills the requirements set forth in the ASAOC.

Consistent with the ASAOC, this RAWP is incorporated into the SWWP as Appendix D. Other project control documents related to the implementation of the RI at the Site include the following:

- Remedial Investigation/Feasibility Study Health and Safety Plan for the 68th Street Landfill, Rosedale, Baltimore County, Maryland, (HASP) (2006) – Appendix A;
- Remedial Investigation/Feasibility Study Field Sampling Plan for the 68th Street Landfill, Rosedale, Baltimore County, Maryland, (FSP) (2006) – Appendix B; and,

- Remedial Investigation/Feasibility Study Quality Assurance Project Plan for the 68th Street Landfill, Rosedale, Baltimore County, Maryland, (QAPP) (2006) – Appendix C.

1.1

REPORT ORGANIZATION

The remainder of this RAWP is organized as follows:

- *Section 2.0 – Data Management.* This section describes data compilation procedures and the sorting of the data for use in the risk assessments;
- *Section 3.0 – Ecological Risk Assessment Work Plan.* This section provides a description of the methods and procedures that will be used to prepare the Screening Level Ecological Risk Assessment (SLERA) for upland and wetland areas and the Baseline Ecological Risk Assessment (BERA) for aquatic environments at the Site;
- *Section 4.0 – Human Health Risk Assessment (HHRA) Work Plan.* This section describes the methods and procedures that will be used to perform the human health risk assessments at the Site; and,
- *Section 5.0 –References.* This section provides the reference documents that will be used during the performance of the SLERA, BERA, and HHRA.

All analytical data collected to support the RI/FS, including existing and future data, will be compiled within the EQuIS™ database for statistical analysis. Summary statistics for each medium will be developed that present information on each constituent, including the maximum and minimum concentration reported, the frequency of detection, and the arithmetic mean of the constituent data set. Samples to be collected in accordance with the FSP and subsequent Management Area (MA) specific work plans will be analyzed according to methods specified in the QAPP. Following USEPA-Region III guidelines for data used to conduct risk assessments, 100 percent of the analytical data to be collected as part of the planned activities will be validated to the USEPA-Region III IM-2 level for inorganic parameters and to the M2 level for organic parameters (USEPA-Region III, 2006). The data validation report will serve as the basis for the data quality evaluation, in which data usability and qualifiers will be incorporated into the Constituents of Potential Ecological Concern (COPECs) and the human health Constituents of Potential Concern (COPCs) selection process.

Analytical data will be compiled and managed as follows:

- *Qualified Data.* Data including estimated values (J-qualified), biased values (L and K-qualified), and other qualified values will be used as the reported value. Blank contamination (B-qualified) and rejected results (R-qualified) will be eliminated from further review.
- *Duplicate Samples.* Data for samples and its field duplicate will be averaged before summary statistics are completed. This will result in a sample and its duplicate being considered as one sample.
- *Non-Detects.* For the purpose of preparing summary statistics, only those constituents with at least one detection will be included; i.e., constituents with no reported detections will not be included in the summary. The appropriate statistical technique for managing constituents with detections reported in some samples and not in other samples will follow the USEPA guidance for calculating exposure point concentrations (USEPA, 2002c). In most cases, one-half of the detection limit will be used for non-detects to calculate the mean concentrations and exposure point concentrations.
- *Frequency of Detection.* The frequency of detection is a ratio based on the number of samples reported with detections for a specific constituent and the number of samples used to calculate the statistic.

- *Mean Concentration.* The arithmetic mean will be calculated for each constituent after duplicates have been averaged and non-detects have been evaluated.
- *Background Concentrations.* Site data will be compared to data representative of background conditions for inorganic constituents. As described in Section 2.9.5 of the FSP, background surface soil samples will be collected and analyzed for metals. The results of soil background samples will be evaluated to determine if they are statistically greater inorganic concentrations reported in samples collected at the Site using the procedures outlined in the *USEPA Guidance for Comparing Background and Constituent Concentrations in Soil for CERCLA Sites* (USEPA, 2002). The first step in the statistical evaluation of the data will be the determination of the distribution (e.g., normal versus log-normal) for each data set. In order to make this determination, *USEPA ProUCL (Version 3.00.02)* (USEPA, 2004) will be utilized. Distributions will be determined only for constituents that were positively detected in both the background and Site data sets; i.e., if a constituent is reported as a non-detect in all background and/or on-Site samples, it will not be included in the distribution analysis.

Following the above distribution analysis, statistical testing will be utilized to evaluate whether the on-Site analytical results are significantly greater than the background results. The statistical test selected for this analysis will be dependent upon the underlying distributions of the on-Site and background data sets. For a given constituent, if both the on-Site and background data sets prove to be normally distributed, the Student's t-statistic (Student t-test) will be utilized. If the data sets are log-normally distributed, or are of different distributions, the Wilcoxon Rank Sum (WRS) Test will be used. Similar to the procedure utilized in conducting the W tests, the WRS test will be completed only when a given constituent is positively detected in both on-Site and background samples. For each analysis, a one-tailed test assuming a 95 percent level of confidence will be employed.

Background (upgradient) surface-water and sediment samples will also be subjected to comparison with Site data.

These data will be used to support the evaluations conducted as part of the Ecological Risk Assessment (see Section 3.0) and the HHRA (see Section 4.0).

3.0

ECOLOGICAL RISK ASSESSMENT WORK PLAN

Ecological risks will be evaluated for each of the upland, wetland, and aquatic environments. For upland and wetland soils (sediments), the evaluation will involve a Screening Level Ecological Risk Assessment (SLERA). The results of the SLERA will be used to guide re-use and remedial decisions. If additional Management Area-specific information is required to guide these decisions, those data will be collected at the appropriate time during a supplemental activity. The sampling currently planned is designed to address data gaps identified to complete the SLERA.

For the aquatic environment, including the runs that pass through the Site, a Baseline Ecological Risk Assessment (BERA) will be conducted. This assessment will incorporate the results of the Preliminary Ecological Evaluation (PRE) presented in the Site-Wide Program Management Plan (SWPMP) as the baseline for the analyses. The PRE (ERM, 2006) indicated that a BERA was the appropriate next step of the evaluation.

The SLERA for upland and wetland areas and BERA for aquatic environments will be conducted in accordance with USEPA guidance, including the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, June 5, 1997 and EPA OSWER Directive 9285.7-28P *Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites*, October 7, 1999. As appropriate, the SLERA and BERA will incorporate additional ecological risk assessment information recommended by the USEPA-Region III Biological Technical Assistance Group (BTAG). The webpage (<http://www.epa.gov/reg3hwmd/risk/eco/index.htm>) provides a listing of all guidance documents that are used by the USEPA BTAG.

3.1

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT FOR UPLAND AND WETLAND AREAS

At the outset of the ecological risk assessment process, the SLERA will address the residual contamination in Site soil and the associated exposure of ecological receptors. The SLERA will follow the USEPA *Ecological Risk Assessment for Superfund Guidance* (USEPA, 1997) and identify potentially affected ecological habitats, contaminants of potential ecological concern (COPECs), exposure pathways, target receptors (plants and animals) and appropriate assessment/measurement endpoints against which the potential for risk will be judged. In general, a SLERA applies conservative screening ecotoxicity values

and conservative assumptions regarding toxicity factors and exposure parameters recommended by the USEPA BTAG to avoid underestimating risk.

The first step in conducting a SLERA is the screening level problem formulation, which describes:

1. The environmental setting and known contaminants at the Site;
2. Contaminant fate and transport at the Site;
3. Mechanisms of ecotoxicity and likely receptors;
4. Complete exposure pathways; and,
5. Selection of screening endpoints.

Assessment endpoints are the biological values to be protected., reproducing populations of wildlife, and the measurement endpoints are the measures of exposure; e.g., COPEC concentrations in media, and measures of effect; e.g., exceedance of no-effect concentrations, necessary to project whether the assessment endpoints are protected.

The second step of a SLERA is the screening level exposure estimate and risk calculation, which describe:

1. The ecological exposure parameters for the receptors; e.g., food ingestion rates for wildlife;
2. Data concerning toxicity of COPECs to receptors; e.g., chronic no-effect concentrations;
3. The calculation of ecological hazard quotients using appropriate dose conversions; and,
4. The uncertainty assessment.

The results of the SLERA are utilized to determine whether the information available is adequate to make a risk management decision. At the Site, the SLERA will be used to guide re-use opportunities and remedial planning for upland and associated wetland environments. Upland and wetland habitats within each Management Area (MA) will be evaluated separately.

3.1.1 *Problem Formulation for the SLERA*

The primary product of the initial problem formulation step is a Site-specific, conceptual model that visually details the information discussed previously and depicts any existing interrelationships.

3.1.1.1 *Environmental Setting*

As indicated, the SLERA will focus on the upland and associated wetland portions of the Site. The Site is located within an urban area on the boundary of the City and County of Baltimore, but contains sensitive habitats which are at the headwaters to the Chesapeake Bay. Further, active and passive re-use of parcels of the Site property are under consideration. Each of these parcels may contain uplands to a greater or lesser extent which are currently forested in some portions of the Site and open in others. The wetland areas include small ponds and bordering vegetated wetlands and forested areas along the runs. These areas are not programmed for active re-use given current land zoning and regulatory protection requirements, and are considered ecological zones. With respect to the potential for ecological receptor contact with constituents available at the Site, the upland portion of the study area is currently predominantly vegetated with tall grasses, shrubs and trees, and the wetland portion of the study area is vegetated with small trees, scrub brush, and wetland vegetation. There are no paved roads and limited structures throughout the entire study area. However, in the vicinity of the I-95 overpass, trails created by recreational vehicles, including all-terrain vehicles (ATVs), and automobiles/trucks, are clearly visible. Both the upland and associated wetland areas of the Site provide habitat for certain ecological receptors. The spatial extent and character of these areas will be examined during the habitat survey to be performed during the Spring season prior to the field sampling event.

The SLERA will evaluate and describe the environmental setting for the terrestrial and associated wetlands portions of the Site. The environmental setting evaluation will be based on information gathered during a qualitative habitat survey which will evaluate the quality, size, and location of habitat types present on the Site. The survey will note dominant vegetation, terrain features, and wildlife observed. The SLERA will present maps depicting the location and extent of these and other environmental setting features. The information gathered during the habitat survey will be combined with information collected during previous investigations and used to identify potential ecological receptors at the Site.

3.1.1.2 *Prior Data Assessment*

The Site has been characterized during previous investigations, as summarized in the SWPMP and PRE. The data generated during these evaluations have been used to identify data gaps for the terrestrial and wetland environments. For the SLERA, these data gaps include the collection of qualitative information on habitats and receptors as well as additional sampling of surface soils and wetland soils and sediments. The data generated will be combined with the existing data sets for use in refining the list of COPECS.

3.1.1.3 *Ecological Toxicity of Identified COPECS*

The SLERA will compare concentrations of COPECS at the Site to toxicity reference values (TRVs) in order to evaluate the potential for toxicity to ecological receptors from exposure to contamination associated with the terrestrial portion of the Site. TRVs are concentrations at which toxicological endpoints are noted in laboratory animal tests. The SLERA is designed to assess potential effects in the types of receptors occupying the Site using reasonably conservative exposure and toxicity assumptions based on USEPA BTAG screening values, USEPA Soil Screening Levels (ECO SSLs), and other appropriate soil screening values such as that obtained from scientific literature, when available.

Useful additional sources of the TRVs for avian and mammalian species include Sample, et al. (1996). In cases where there are no readily available values for screening, the USEPA-BTAG will be consulted regarding the specific COPECS and a determination whether a quantitative assessment is required. In such cases, insight will be sought from literature reviews via the USEPA ECOTOX on-line database and/or scientific literature. The latest versions of toxicological profiles compiled by the Agency of Toxic Substances and Disease Registry (ATSDR), the USEPA Integrated Risk Information System (IRIS), and/or other scientific literature will be researched for appropriate mammalian TRVs.

During problem formulation, this evaluation will be used to prioritize the COPECS relative to Site-specific conditions.

3.1.1.4 *Potential Ecological Receptors*

Based on a review the habitats present in the upland and associated wetland portions of the Site, the potential receptors to be used in the SLERA exposure evaluations include:

- Soil invertebrates;
- Upland and wetland plants;

- American Robin (*Turdus migratorius*) as an avian invertivore;
- Meadow Vole (*Microtus pennsylvanicus*) as a mammalian herbivore;
- Long-Tailed Weasel (*Mustela frenata*) as a mammalian carnivore;
- Short-Tailed Shrew (*Blarina brevicauda*) as a mammalian omnivore;
- Mourning Dove (*Zenaida macroura*) as an avian herbivore;
- Red-Tailed Hawk (*Buteo jamaicensis*) as an avian carnivore; and,
- American Woodcock (*Scolopax minor*) as an avian omnivore.

These species were selected based upon their clear direct or indirect exposure pathway link to soil, foraging in terrestrial habitats and associated wetlands, and common presence in upland and wetland environments in North America; they therefore serve as appropriate surrogate species in a screening-level evaluation.

The exposure evaluation will also include potential toxicity to vegetation at the Site caused by exposure to contamination.

3.1.1.5 Complete Exposure Pathway

A complete exposure pathway requires:

1. a source and mechanism of release of the constituent;
2. a transport or retention medium;
3. a point of exposure or contact with the constituent; and
4. an exposure route (e.g., ingestion or dermal contact) to the receptor.

An exposure pathway is considered complete if the ecological receptor can contact the COPECS in a medium.

The Conceptual Site Model (CSM) was presented in the PRE and will be revised as and if appropriate for the MA-Specific Risk Assessment Work Plans. The key transport pathways presented in the CSM are further evaluated herein and will be iteratively refined throughout the ensuing Site investigation and risk assessment process. Accordingly, the potential contaminant transport pathways for the upland and wetland habitats include the following:

- Waste materials in direct contact with the surface-water and groundwater within the wetlands;
- Indirect contact with waste materials through groundwater discharge into the adjoining surface-water bodies within the wetlands;

- Direct exposure to surface and subsurface waste materials and contaminated soils; and,
- Constituent uptake; e.g., PCBs, and potential bioaccumulation from soil into plant and animals that serve as prey for other animals.

From these potential contaminant transport pathways, ecological receptor exposure pathways for the Site will be evaluated. The SLERA will include an evaluation of all potential exposure pathways to determine which are complete and, therefore, pose a risk to ecological receptors. The complete exposure pathways will be summarized using ecological conceptual Site models.

3.1.1.6 *Assessment and Measurement Endpoints*

According to the USEPA guidance (USEPA, 1997a), assessment endpoints for SLERAs are established for the protection of ecological receptors, where the receptors are local plant and animal populations and communities, habitats, and sensitive environments present at the Site. Adverse effects on populations can be inferred from impaired reproduction, growth, and survival. Adverse effects on communities can be inferred from changes in community structure or function, and adverse effects on habitats can be inferred from changes in composition and characteristics that reduce the habitat ability to support plant and animal populations and communities. The SLERA will identify and evaluate both the assessment endpoints and their corresponding measurement endpoints.

3.1.2 *Screening Level Exposure Estimate and Risk Calculation*

3.1.2.1 *Ecological Exposure Parameters for Receptors*

The exposure parameters used to estimate risk to wildlife in the SLERA will be obtained from the *Guidance for Developing ECO SSLs* (USEPA, 2005) and the *Wildlife Exposure Factor Handbook* (USEPA, 1993). The *Guidance for Developing ECO SSLs* provides exposure factors, including the body weights, food ingestion rates, soil ingestion rates and assumed diets for the meadow vole, short-tailed shrew, long-tailed weasel, mourning dove, American woodcock, and red-tailed hawk. This guidance document does not, however, provide water ingestion rates or foraging areas. Water ingestion rates and foraging areas for the wildlife receptors will therefore be obtained from the *Wildlife Exposure Factor Handbook* (USEPA, 1993), which provides ranges of typical ingestion rates of water, as well as foraging areas of many wildlife species. If a required exposure parameter is not provided in the *Guidance for Developing ECO SSLs* or the *Wildlife Exposure Factor Handbook*, other sources will be researched.

Because of its intended conservatism, the SLERA will assume that wildlife receptors only forage within the Site boundaries. Therefore, in the SLERA food

web models, the area use factor (AUF) will be set to 1 for all receptors. It should be noted that the foraging area for some receptors and the area of interest are not consistent. For example, exposure to Site-related COPECs by a red-tailed hawk that forages inside and outside of the Site will probably be less than an animal that forages only within the Site. Therefore, a discussion of foraging areas may be included in the uncertainty section of the SLERA to address the potential for over-estimation of risk.

3.1.2.2 *Data Concerning Toxicity of COPECs to Receptors*

The SLERA will use the soil and sediment benchmarks discussed previously as a basis for judging the implications of exposure by ecological receptors.

3.1.2.3 *Calculation of Ecological Hazard Quotients*

The basic formula for calculating an ecological hazard quotient (HQ) is:

$$HQ = EPC_{(receptor)} / Benchmark_{(receptor)}$$

where:

$EPC_{(receptor)}$ = the soil or sediment exposure "point" concentration that is relevant to the receptor, and,

$Benchmark_{(receptor)}$ = the soil or sediment benchmark concentration that is relevant to the receptor.

Benchmarks can be available for TRVs expressed as No Observable Adverse Effect Levels (NOAELs) or Lowest Observable Adverse Effect Levels (LOAELs). In some cases, these benchmarks must alternatively be derived. The resulting HQs are interpreted as:

- If both the NOAEL- and LOAEL-based HQs are less than 1, there is no indication of a potential for harm;
- If both the NOAEL-based and LOAEL-based HQs are greater than 1, there is an indication of potential for harm;
- If the NOAEL-based HQ is greater than 1, but the LOAEL-based HQ is less than 1, there is uncertainty in the evaluation of risks at the SLERA level; such uncertainty is characterized as input to subsequent management decisions.

Since the SLERA will be used to identify locations that may contribute to potential ecological risk, calculations will be made and plotted for each of the sample locations. These will also be aggregated into average exposures that are

consistent with the spatial scales or the ecological receptors using either maps, as in the PRE, or applying the average concentration with area curve methodology (Freshman and Menzie, 1996). If benchmark concentrations or toxicological data are not available for some of the detected constituents, the risk associated with exposure to these constituents cannot be calculated. In these cases, the SLERA will include a discussion of the implications of these information gaps.

3.1.2.4 *Estimates of Exposure Via the Food Web*

Benchmarks have been developed for a number of COPECS for which exposure can occur via the food web. Where these values are available they will be used; however, there may be some cases where values are not available, but the potential for food-chain transfer exists. If the Constituents are judged to be potentially important for decision-making, a food-chain wildlife exposure model will be used. The dose is calculated by multiplying the combined ingested dose (normalized by body weight) from applicable ingestion sources, such as drinking water, invertebrates, plants, and soil, by the area use factor and migration factors.

The general form of the wildlife exposure model is:

$$\text{Exposure Dose (oral)} = [(C_{\text{food}} * IR_{\text{food}}) + (C_{\text{soil}} * IR_{\text{soil}}) + (C_{\text{water}} * IR_{\text{water}})] * \text{AUF}$$

where:

Exposure Dose (oral) units = Dietary dose of COPEC/kilogram [kg] body weight/day;

C_{food} = Concentration of the COPEC in food (milligrams/kilogram [mg/kg] wet weight) in the food;

IR_{food} = Daily food ingestion rate, normalized to body weight (kg wet weight food/kg body weight /day);

C_{soil} = Concentration of the COPEC in soil of the relevant exposure zone (mg/kg dry weight);

IR_{soil} = Daily soil ingestion rate, normalized to body weight (kg dry wet soil/kg body weight /day);

C_{water} = Concentration of the COPEC in surface water (milligrams/liter [mg/L]) of the relevant exposure zone;

IR_{water} = Daily water ingestion rate, normalized to body weight (L water/kg body weight /day);

AUF (Area Use Factor) = Fraction of the receptor foraging range that is represented by the study area under consideration. For the SLERA, the AUF is set to 1 for all receptors, even those with foraging areas larger than the study area.

For wildlife that consume various types of food, dietary doses from each food source will be summed to estimate the total exposure dose.

3.1.2.5 *Uncertainty Evaluation for SLERA*

Sources of uncertainty and variability within the SLERA will be identified. The impact associated with these uncertainties will be qualitatively addressed.

3.2 ***BASELINE ECOLOGICAL RISK ASSESSMENT (BERA) FOR AQUATIC ENVIRONMENTS***

The baseline ecological risk assessment for the aquatic environments of the Site will be conducted in accordance with the prevailing USEPA-Region III guidance and USEPA-BTAG guidance, as discussed in Section 3.0. Additional guidance specific to the BERA will be sought, as appropriate, from the following sources:

- USEPA. 2002a. *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver and Zinc)*;
- USEPA. 2003a. *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixture; and,*
- USEPA. 2000. *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates - Second Edition.*

3.2.1 ***Problem Formulation***

Consistent with the above-referenced guidance, the ecological risk assessment will include:

- Description of a Conceptual Site Model;

- Identification of COPECS;
- Selection of assessment endpoints;
- Selection of receptors;
- Selection of measurement endpoints and their relation to assessment endpoints;
- Risk characterization; and,
- Discussion of uncertainties and assumptions.

3.2.1.1 *Conceptual Site Model*

The foundation of an ecological risk assessment is the Conceptual Site Model. According to USEPA guidance, the conceptual Site model must address:

- Environmental setting and COPECS known or suspected to exist at the Site;
- COPECS fate and transport mechanisms;
- Mechanisms of ecotoxicity and likely categories of potentially affected receptors; and,
- Complete exposure pathways.

A complete exposure pathway occurs whenever there is a source of contamination; a fate and transport mechanism which delivers a COPECS to a receptor; and an exposure route which results in uptake of the COPECS by the receptor. The CSM was presented in the PRE and will be revised as and if appropriate for the BERA.

3.2.1.2 *Environmental Setting and COPECS Known or Suspected to Exist at the Site*

There are three recognized flowing water bodies or “runs” that abut or pass through the Site: Herring Run, Moores Run and Redhouse Run. These vary in width, depth, and flow depending on reach. These open water areas will be the main focus of the BERA because of their importance as an ecological and recreational resource, because they can potentially receive Site-related contaminants from the closed Source Areas, and because they are part of the larger Herring Run and Back River watersheds. A further description of the aquatic environments has been described in the PRE.

The PRE identified both inorganic and organic COPECS for consideration in the BERA. The planned sampling (see the FSP) may indicate that some of these COPECS are no longer present. Further, sampling may also indicate that there are COPECS that have not been previously identified.

Metals commonly exceeded the sediment screening benchmarks; in decreasing order of occurrence: lead, zinc, copper, nickel, chromium, mercury, cadmium and arsenic were identified. These metals will be considered COPECs in the BERA. Four other metals; lead, nickel, chromium, and zinc, are judged to be present at exposure levels that could pose a risk. Metals are also present in upland areas and, therefore, are potentially Site-related. These metals can act additively or antagonistically with regard to potential effects on benthic invertebrates. Exposures can occur through direct contact and, to a limited degree, from bioaccumulation into invertebrates. None of these metals are transferred through the food web with the possible exception of mercury, when present in an organic form.

Polycyclic Aromatic Hydrocarbons (PAHs) were commonly observed in sediments at levels higher than screening values and will be considered COPECs in the BERA. Because elevated concentrations of PAHs were also present in upland areas within the Site, this group of constituents is potentially Site-related. These compounds can have direct effects upon benthic invertebrates and also affect fish. Therefore, the full suite of PAHs required for evaluation using the ESBs for PAH mixtures may be analyzed in a subset of sediment samples if sediment toxicity tests and sediment chemistry results suggest that PAHs may have direct effects upon the test species. Black carbon content of sediments may also be measured in the same subset of sediment samples.

Chlorinated pesticides exceeded benchmarks in many sediment samples, thus these constituents will be considered COPECs in the BERA; however, the observed concentrations tend to be low. PCBs and dioxins, while present at the Site, do not appear to be present at elevated levels in sediments. Dioxins will nevertheless be measured in select soil and sediment samples to confirm the low concentrations. Chlorinated pesticides and PCBs bioaccumulate and can be transferred through the food web.

While residual volatile organic compounds (VOCs) may be associated with the on-Site Source Areas, VOCs do not bioaccumulate and are generally not considered to be a potential issue in the aquatic habitats. However, VOCs will nevertheless be measured in groundwater samples as part of the Site investigation and such data will be evaluated in the BERA to assess if these constituents should be considered COPECs.

All the groups of compounds observed in the sediments are commonly found in urban watersheds. For this reason, an assessment of background conditions will be an important aspect of evaluating the levels observed in the streams at the Site.

In an aquatic system, various physical, constituent, and biological transport mechanisms will affect the fate and transport of COPECs. Several mechanisms are more important for COPECs that tend to associate with particles and hydrophobic phases, and other mechanisms are important for more water-soluble COPECs. The conceptual Site model addresses and defines the important fate and transport mechanisms operating in the aquatic portions of the Site. The predominant physical and constituent mechanisms include:

- possible discharge of contaminated groundwater from the Site into the runs;
- transport of dissolved and particulate-associated COPECs into the runs of the Site;
- deposition of particle-associated COPECs in areas of low flowing waters and association with sediment organic carbon;
- burial of contaminated sediments by the subsequent deposition of cleaner materials; and,
- transport of dissolved and particulate-associated COPECs from the runs into Back River.

Evaporation of COPECs from the streams and atmospheric deposition of COPECs into the runs are expected to be less significant fate and transport mechanisms. The predominant biological mechanisms affecting fate and transport are:

- absorption from sediment or surface water;
- bioaccumulation through ingestion of contaminated prey or media;
- biomagnification through the food web; and,
- metabolism and degradation of COPECs by microbes or higher organisms.

The BERA will describe the COPECs in terms of the fate and transport mechanisms most likely to affect them.

The BERA will provide detailed ecotoxicity profiles for the final list of COPECs, to include summaries of the toxicity of these constituents to receptors likely to

occur in the aquatic areas of the Site. The categories of potentially affected receptors for Herring Run, Moores Run and Redhouse Run include:

- Benthic macroinvertebrate community;
- Fish; and,
- Semi-aquatic wildlife (turtles, mammals and birds).

As discussed in the PRE, these categories of receptors were identified in most habitats in Herring Run, Moores Run and Redhouse Run.

The selected aquatic receptor species will represent those types of organisms most likely to encounter the COPECs at the Site, and will include a reasonable, although not comprehensive cross-section of the major functional and structural components of the ecosystem under study based on:

- relative abundance and ecological importance within the selected habitats;
- availability and quality of applicable toxicological literature;
- relative sensitivity to the COPECs;
- trophic status;
- relative mobility and local feeding ranges; and,
- ability to bioaccumulate COPECs.

Based on a review of the habitats present in the aquatic portions of the Site, the potential fish receptors to be used in the BERA exposure evaluations include:

- Killifish (*Fundulus sp.*) and centrarchids (e.g., pumpkinseed) as a forage fish; and,
- White Perch (*Morone americana*) as omnivorous fish.

Similarly, based on a review the habitats present in the aquatic portions of the Site, the potential wildlife receptors to be used in the BERA exposure evaluations include:

- Great Blue Heron (*Ardea herodias*) as an avian piscivore;
- Belted Kingfisher (*Ceryle alcyon*) as a mammalian piscivore; and,
- Raccoon (*Procyon lotor*) as a mammalian piscivore.

These species were selected because each has a clear direct or indirect exposure pathway link to sediment, forages in aquatic habitats, and is common in aquatic environments in North America; they therefore serve as appropriate surrogate species in a BERA.

3.2.1.5 *Complete Exposure Pathways*

The USEPA guidance indicates that the risk assessment should identify complete exposure pathways so that the assessment can focus on those COPECs that can actually reach ecological receptors. The likely complete exposure pathways include:

- Sediment to fish and benthic invertebrates through direct uptake and ingestion;
- Sediment and surface water to aquatic plants through direct uptake;
- Surface water to invertebrates and fish through direct contact and ingestion; and,
- Sediment and surface water via food web pathways to higher organisms; e.g., turtles, mammals, and birds, through ingestion.

The exposure evaluation will also include potential toxicity to vegetation at the Site caused by exposure to contamination.

3.2.2 *Study Design for Risk Assessment*

The BERA will be based on a weight-of-evidence approach (Menzie, et al., 1996) that will relate the measurement endpoints to assessment endpoints. A sampling plan will be designed to support the risk assessment using the overall approach described below.

3.2.2.1 *Selection of Assessment Endpoints*

Assessment endpoints are expressions of the environmental value to be protected at a Site. The selection of assessment endpoints requires the consensus of all stakeholders, including the regulatory agencies, the regulated community, and state or local concerns. This RAWP proposes the following assessment endpoints for the potentially affected aquatic receptors and their habitats:

- Sustainability (survival, growth and reproduction) of a benthic invertebrate community;
- Sustainability (survival, growth, and reproduction) of a fish population; and,

- Sustainability (survival, growth, and reproduction) of local populations of semi-aquatic wildlife.

3.2.2.2 *Selection of Measurement Endpoints*

When assessment endpoints are not directly measurable, risk assessments examine measures of effects. Measurement endpoints are quantifiable characteristics that reflect the assessment endpoint (USEPA, 1997a). In a weight-of-evidence approach (Menzie, et al., 1996), each measurement endpoint is judged or weighed qualitatively by considering:

- Strength of association between the measurement endpoint and the assessment endpoint;
- Data quality; and,
- Study design and execution.

Strength of association refers to how well a measurement endpoint represents an assessment endpoint. The greater the strength of association between the measurement and assessment endpoint, the greater the weight given to that measurement endpoint in the risk analysis. The weight given to measurement endpoint also depends on the quality of the data as well as the overall study design and execution.

Measurement Endpoint for Assessment Endpoint 1: Sustainability of a benthic invertebrate community

Benthic invertebrates are sessile, non-migratory organisms that are important elements of aquatic and semi-aquatic food webs. Because of their close association with the sediment, benthic invertebrates may be exposed to COPECs in the sediment at the Site. These measurement endpoints will be evaluated in addition to screening against sediment benchmarks that was performed in the PRE.

Measurement Endpoint 1a: Sediment Chemistry

Rationale. Sediment chemistry can provide a means for judging the potential for exposure and effects when measures of exposure are combined with literature-based values for effects. Sediment chemistry can also be used to interpret other measurement endpoints, such the results of sediment toxicity tests.

Approach.: Data on sediment chemistry will be used to evaluate exposure and the potential for effects. Concentrations of COPECs in sediment will also be compared to *Threshold Effect Concentrations and Probable Effect Concentrations* (MacDonald et al., 2000) to judge whether adverse biological effects to benthic macroinvertebrates could be occurring. However, concentrations exceeding sediment-screening levels do not necessarily indicate that adverse effects to benthic macroinvertebrates are occurring.

The bioavailability of the constituents will be evaluated using existing USEPA guidance. The bioavailability of metals in sediments to sediment pore water and the overlying water column can be examined by measuring the concentration of acid volatile sulfides in the sediment. Within sediments, much or all of the metals can be bound by sulfides; this binding capacity will be determined by measuring the level of acid volatile sulfides (AVS). If the amount of AVS exceeds the amount of simultaneously extracted metals (SEM), then the metals are unavailable for leaching into pore water or the overlying water column. Similarly, the bioavailability of PAHs in sediments to sediment pore water and the overlying water column can be examined by measuring black carbon and organic carbon content and individual PAH concentrations in sediments. Most of the PAHs may be bound by the organic phases in the sediments. PAH binding to organic phases can be accounted for by applying the *USEPA ESB approach* (USEPA, 2000). In addition, bioavailability of sediment-associated metals and organic contaminants can be influenced by the organic carbon and black carbon content of the sediment, which will also be measured.

Because the Site is located within an urban watershed, there may be other sources of COPECS that can confound the analysis of Site-related risks. These other sources include upstream sources contributing to Herring, Moores and Redhouse Runs, storm sewer discharges to the runs from other sources adjacent to the Site, the Back River Publicly-Owned Treatment Works (POTW), and other downstream industrial dischargers to the Back River. The POTW and other downstream sources can be a confounding factor because it has historically discharged constituents to the Back River and because the system is tidal with an upstream component on incoming tides. This component can transfer sediments upstream and potentially influence surface-water quality conditions within the Site during high tides. Samples will therefore be collected in upstream reference locations to assist in discerning between regional and Site-specific exposures. The concentrations of COPECs in sediment samples will be compared to the concentrations of COPECs in upstream samples to examine the potential for exposure of benthic invertebrates to Site-related COPECs.

Measurement Endpoint 1b: Sediment Toxicity Test Comparison to Reference Areas

Rationale. Sediment toxicity tests provide a direct measure of adverse effects to benthic invertebrates. They also provide information regarding the integrated effect of exposure to the mixture of COPECS in sediment. Information on the toxicity of the mixture of COPECS is an important addition to that on the potential toxicity of individual compounds.

Approach. Sediment toxicity testing will include the 28-day sediment toxicity test with the freshwater amphipod *Hyaella azteca*, following the procedures in *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates - Second Edition* (USEPA, 2000), which includes measures of growth and mortality. Statistically significant decreases in survival, reproduction, and growth of organisms exposed to sediments or wetland soil relative to controls and reference locations may be considered a COPECS-related effect. However, effects due to factors that are not related to the concentration of COPECS, such as sediment particle-size distribution, organic carbon content, and concentrations of ammonia must also be considered. A total of nine (9) toxicity tests will be conducted in the runs upstream of the Site, within the Site region, and downstream of the Site. Sampling for the toxicity tests will occur in the Summer or early Fall season.

Measurement Endpoint 1c: Qualitative Evaluation of Benthic Fauna

Rationale. The community of the benthic invertebrates in the three primary runs at the Site will be qualitatively evaluated to interpret whether benthic fauna are being exposed to COPECS at the Site.

Approach. The benthic invertebrate fauna will be qualitatively observed to interpret exposures. However, variations in benthic community structure will not be used to evaluate effects because of the high variability in substrate, salinity and stream flow in the Site system. The qualitative evaluation of benthic invertebrates will be performed during the Summer or early Fall season.

Measurement Endpoints for Assessment Endpoint 2: Sustainability of Warm Water Fish Population

Fish entering the runs at the Site on the incoming tide, or that inhabit the runs continually, could be affected directly or indirectly by Site-related COPECS. Direct toxic effects could occur via exposure to the COPECS in the water and sediment, or by consumption of contaminated prey. Indirect effects could occur if COPECS in sediments affect the abundance of macroinvertebrates that are prey for the fish. Measurement endpoints that relate to indirect effects on fish; e.g.,

loss of invertebrate prey, are described in the previous section. Measurement endpoints that relate to direct effects on fish are described below.

While this assessment focuses on warm water fish species because they are resident species, it will also address anadromous fish species that may seasonally use the runs at the Site.

Measurement Endpoint 2a: Surface-Water Chemistry

Rationale. The accumulation of COPECs from surface water via the gills may possibly have an adverse effect on the survival, growth, and reproduction of fish that inhabit or use the runs at the Site. Fish can also be exposed to constituents in the sediments (Measurement Endpoint 1a). Surface water and sediment chemistry provide a means for judging the potential for exposure and the effects when measurements of exposure are combined with literature-based values for effects. These data can also be used to aid in interpreting other measurement endpoints.

Approach. Surface-water measurements will be compared to state and federal surface-water quality criteria (AWQC) designed to be protective of aquatic biota. Comparisons will consider regional as well as Site-specific measurements.

Measurement Endpoint 2b: Body Burdens of COPECS in Fish Compared to Body Burden Toxicity Reference Values

Rationale. Fish exposed to constituents in their diets or in water can accumulate these constituents in their tissues. Such accumulation may result in adverse effects on the survival growth and reproduction of the fish population. Concentrations of COPECS in the tissue of fish that inhabit the runs flowing through the Site will be compared to concentrations in upstream reference areas to assess the degree of Site-specific exposure. Resident fish species will be selected over anadromous fish species for tissue analysis because resident fish will likely exhibit higher body burdens of Site-related COPECs than anadromous fish. Concentrations of COPECS will also be compared to critical body residue (CBR) values for both resident and anadromous fish to judge the potential for adverse effects.

Approach. Concentrations of mercury, chlorinated pesticides and PCBs in whole fish collected from the runs passing through the Site will be compared to concentrations in fish collected from upstream reference locations. Fish lipid content will also be measured. Concentrations in whole fish will also be compared to CBRs representing the effects on critical life stages, such as reproduction and development of eggs and larvae.. The U.S. Army Corps of Engineers Environmental Residue Effects Database (USACE, 1998) will be used as a

source of toxicity benchmarks that are based on tissue concentrations. Measured concentrations will also be used in food web models, as described in Measurement Endpoint 3a. Four composite samples of fish samples, one from each of the three runs and one from an upstream location, will be collected and analyzed for concentrations of mercury, chlorinated pesticides and PCBs. Fish species will be selected to represent appropriate prey sizes for semi-aquatic wildlife. Target species include killifish, small white perch and small centrarchids. Fish sampling will occur during the Summer or early Fall seasons.

Measurement Endpoint 2c: Qualitative Evaluation of Fish Community

Rationale. The community of fish in the three runs at the Site will be qualitatively evaluated to interpret whether fish are being exposed to COPECS at the Site.

Approach. Qualitative observations of the fish community will be employed to interpret exposures. However, variations in fish community structure will not be used to evaluate effects because of the high variability in salinity and stream flow in this system. The qualitative evaluation of fish will occur during the Summer or early Fall seasons. Observations of anadromous fish will be included in the qualitative survey of aquatic biota.

Measurement Endpoints for Assessment Endpoint 3: Sustainability of Local Populations of Wildlife

Measurement Endpoint 3a: Measurement of COPECS in Fish Used as Prey and Sediment Use in Food Web Models

Rationale. Wildlife (turtles, mammals, and birds) are exposed to COPECS in food items via the food web. For selected receptors at the Site, the primary food item considered is fish. This measurement endpoint therefore evaluates this potential route of exposure by measuring concentrations of COPECS in fish.

Approach. Whole forage fish such as killifish, small centrarchids, or small white perch will be collected from the runs and analyzed for COPECS as described in Measurement Endpoint 2b.

The concentrations measured will be used in the multi-pathway exposure model for wildlife that considers the uptake of COPECS from sediment and food. These models will incorporate reasonably conservative exposure parameters, including ingestion rates, body weights, and percentage of diet per food item. Migration and foraging areas will be incorporated and average exposure concentrations of COPECS in the appropriate exposure area will be used. Potential exposures to wildlife will be compared to: 1) appropriate NOAELs and LOAELs; and, 2) potential exposures that occur in the identified reference areas. Additional

toxicity information will be identified, where possible and if necessary for compounds for which no NOAEL or LOAEL value was identified previously.

Exposure point concentrations for wildlife used in the food web models will most likely be the 95th percentile upper confidence limit on the mean. In cases where the 95th UCL is greater than the maximum concentration, the maximum concentration will be used as the exposure point concentration in the food web models.

The BERA will compare estimated doses of COPECS to wildlife with TRVs in order to evaluate the potential for toxicity to wildlife receptors from exposure to contamination associated with the aquatic areas of the Site. TRVs are concentrations at which toxicological endpoints are noted in laboratory animal tests. The BERA is designed to assess potential effects in the types of receptors utilizing the Site using reasonably conservative exposure and toxicity assumptions. The BERA will use TRVs in the USEPA ECO SSLs documents, TRVs from Sample et al. (1996), and other appropriate TRVs when available.

In cases where there are no readily available values for screening, the USEPA-BTAG will be consulted regarding the specific COPECS and the requirement for quantitative assessment. In such cases, literature reviews through the USEPA ECOTOX on-line database and/or scientific literature will be utilized. The latest versions of toxicological profiles compiled by the ATSDR, the USEPA IRIS, and/or scientific literature will assist in establishing TRVs for appropriate mammals.

The exposure parameters used to estimate the risk to wildlife in the BERA will be obtained from the *Wildlife Exposure Factor Handbook* (USEPA, 1993). The *Wildlife Exposure Factor Handbook* provides exposure factors, including the body weights, food ingestion rates, sediment ingestion rates, foraging areas and assumed diets for the great blue heron, belted kingfisher and raccoon. This guidance document does not provide water ingestion rates or foraging areas. If a required exposure parameter is not provided in the *Wildlife Exposure Factor Handbook*, other sources will be researched.

Foraging areas will be identified for each receptor since in some cases, the foraging area for a receptor and the area of interest are not consistent. This situation will be particularly important in cases where the foraging area of a receptor is larger than the area of interest. For instance, a raccoon that is foraging inside and outside of the Site will probably be less exposed to Site-related COPECS than an animal that forages only within the Site. In the food web models, an AUF will therefore be determined for the raccoon and applied to the exposure dose in order to avoid such over-estimations of risk.

Little information exists on the toxicity of Site-related constituents to turtles. A literature review of existing information will be included in this assessment, and toxicity reference values specific to turtles will be derived wherever possible.

Measurement Endpoint 3b: Qualitative Evaluation of Wildlife.

Qualitative and quantitative observations will be made of wildlife habitats throughout the Site. This survey will be used to identify the wildlife species that utilize the area as well as those that might be expected to use the area. The survey will include an evaluation of the vegetation in uplands, marsh, banks, and open-water areas. These observations, together with an examination of the physical features of the system, will be used to assess the current quality of habitat and the extent of these habitats. This information will also be used to identify options for the restoration of areas that would yield a net environmental benefit.

3.2.3 Risk Characterization for the Ecological Risk Assessment

Risk results will be presented as calculated hazard quotients as well as other measures, such as the presence of toxicity. These results will be incorporated into the weight of evidence approach (Menzie et al., 1996) in the form of graphs and tables, and will be explained in narrative descriptions. The results will be used to refine estimates of the potential risk identified in the PRE. For example, for benthic invertebrates, the PRE identifies a potential risk if a COPEC exceeds a sediment benchmark level. The BERA will include measures of toxicity to a benthic invertebrate. For wildlife species, food web modeling will employ actual measured concentrations of COPECS in food items rather than reliance only on benchmark values.

3.2.3.1 Use of Hazard Quotients

The hazard quotient is one of the more common methods used to express results. This method involves a comparison of exposure concentrations for COPECs to the doses related to effects, as:

$$\text{Hazard Quotient} = \frac{\text{Dose}_{\text{exposure}}}{\text{Dose}_{\text{effects}}}$$

where:

$\text{Dose}_{\text{exposure}}$ = the dose to which an organism is exposed; and,

$\text{Dose}_{\text{effects}}$ = the dose at or above which effects may occur.

If the hazard quotient exceeds 1.0, there is potential for an adverse effect. To some extent, the higher the number above 1.0, the more likely would an effect occur. Calculations of hazard quotients must account for both spatial and temporal factors inasmuch as these are related to the effect that might occur to populations of biota.

3.2.3.2

Discussion of Uncertainties and Exposure Assumptions

Sources of uncertainty and variability within the ecological risk assessment will be identified, and the impact associated with these uncertainties will be qualitatively addressed. If appropriate, sensitivity analyses will be conducted for the important exposure parameters that will be used in the wildlife exposure models and for the TRVs that will be used to determine risk to the representative wildlife species. Constituents for which no benchmarks or TRVs are available will be identified and, if possible, screening concentrations will be developed for these constituents from the literature.

4.0

HUMAN HEALTH RISK ASSESSMENT WORK PLAN

4.1

RISK ASSESSMENT METHODOLOGY

The human health risk assessment (HHRA) will be conducted in accordance with USEPA guidance for the preparation of risk assessments; several of the primary risk assessment documents that may be employed include:

- *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part A* (1989a);
- *Interim Procedures for Estimating Risk Associated with Mixtures of Chlorinated Dibenzo-p-dioxins and Chlorinated Dibenzofurans (CDDs and CDFs) and 1989 update* (1989b);
- *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part B - Development of Preliminary Remediation Goals (PRGs)* (1991a);
- *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (1991b);
- *Guidelines for Exposure Assessment* (1992);
- *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening* (USEPA Region III, 1993);
- *Guidelines for Cancer Risk Assessment* (1996a, 1999, 2003b);
- *Soil Screening Guidance: Users Guide and Technical Background Document* (1996b);
- *Exposure Factors Handbook* (1997b);
- *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part D - Standardized Planning, Reporting and Review of Superfund Risk Assessments* (2001);
- *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Part E - Supplemental Guidance for Dermal Risk Assessment* (2002c);
- *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (2002b);
- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (2002d);
- *Human Health Toxicity Values in Superfund Risk Assessments* (2003c);
- *Child-Specific Exposure Factors Handbook* (2002e); and
- *Updated Dermal Exposure Assessment Guidance* (USEPA Region III, 2003).

In accordance with the above-listed guidance documents, the HHRA will include the traditional four steps defined by the National Academy of Sciences (1983) in their report, *"Risk Assessment in the Federal Government: Managing the Process."* These steps are as follows:

- Hazard Identification;
- Exposure Assessment;
- Toxicity Assessment; and,
- Risk Characterization, including an Uncertainty Assessment.

The following sections of this HHRA work plan describe each of these steps and identify key issues involving specific conditions pertinent to the Site. The PRE that was conducted as part of the SWPMP will serve as the baseline framework for the conduct to the Management Area-specific HHRA's.

4.2 HAZARD IDENTIFICATION

The hazard identification process: 1) evaluates the nature and extent of constituents reported at the Site; and, 2) selects a subset of constituents identified as Constituents of Potential Concern (COPCs). For the hazard identification, all analytical data, including previously collected data and currently planned sampling data, will be compiled in the EQuIS™ database. From this compilation, the data will be analyzed for risk assessment purposes. The components of the hazard identification are described in the following section.

4.2.1 Identification of COPCs

A preliminary evaluation of COPCs in soil, waste, groundwater, surface water and sediment was presented in the SWPMP (November 2006). The preliminary evaluation identified several inorganic and organic COPCs; however, only a few COPCs were observed above the screening levels in sampling locations across the Site.

After the collection of additional samples to mitigate data gaps, as described in the SWPMP, the data compiled in the EQuIS™ database will be re-evaluated to identify COPCs for each Management Area. The identification of COPCs will be performed following the approach outlined in USEPA-Region III guidance on selecting constituents of concern (USEPA Region III, 1993) using the most recent version of the USEPA Region III Risk-Based Concentration (RBC) Tables. Consistent with the USEPA-Region III guidance, the target risk level used to derive risk-based concentrations will be equal to a hazard quotient of 0.1. Thus, the RBCs used for non-carcinogenic constituents differ from the values presented on the RBC Table, which utilize a target risk value of 1.0.

The reported maximum constituent concentrations and detection limits will be compared to the most current USEPA-Region III RBCs as follows:

- Soil and waste data, derived from depths up to 15 feet below ground surface, will be compared to the industrial soil RBCs;
- Groundwater data will be compared to tap water RBCs;
- Surface-water data will be compared to available ambient water quality criteria for human health;
- Sediment data will be compared to 10 times the residential soil RBCs;
- Tissue will be compared to the RBCs for fish; and,
- Soil gas data will be compared to screening levels provided in the most recent USEPA guidance, or the USEPA 2002 OSWER *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*, as appropriate. If necessary, Site-specific screening levels may be estimated using the most recent version of the Johnson & Ettinger (USEPA, 2004; USEPA, 2007 on-line version) screening models.

Essential nutrients, as defined by the USEPA (1989a), including calcium, iron, magnesium, sodium, and potassium, do not require evaluation in a quantitative HHRA when they are present at low concentrations; i.e., only slightly elevated above background levels, and are toxic only at very high doses. Screening values are not available for calcium, magnesium, sodium, or potassium, but screening values are available for iron. Consequently, iron concentrations will be compared to the most recent RBCs and to the Site background concentration. The remaining nutrients: magnesium, sodium, and potassium, will also be compared to the Site background. Essential nutrients that are not eliminated based on the RBC or the background comparison will be evaluated further using a weight of evidence approach to determine if they should be included in the HHRA.

The results of the comparison of on-Site concentrations to background concentrations, described in Section 2.0, will be included as part of the identification of COPCs. However, all Site constituents that exceed risk-based screening levels will be retained in the quantitative risk assessment. Site constituents that are above risk-based screening levels that are considered naturally occurring elements based on Site background levels will be discussed in the Risk Characterization section of the risk assessment report.

4.2.2

Summary of Constituents of Potential Concern

The results of the PRE identified several inorganic and organic COPCs; however, for each medium, only a few COPCs were observed to be above the screening levels in sampling locations across the Site. Such COPCs included arsenic, lead

and benzo(a)pyrene. Other COPCs were reported but were not pervasive across the Site. For most COPCs, exceedances were less than 10 times (10x) the screening level; higher exceedances (e.g., 10x to 100 x the screening level) occurred in relatively small areas of the Site.

PAHs have been commonly observed in waste and sediment samples at levels higher than the screening values. Potential exposure to these constituents could result in elevated risks for human receptors. Likewise, dioxins and furans have been detected immediately below the 2,3,7,8 TCDD screening level in one sediment sample located in the lowland area. The presence of volatile organic constituents detected in soil, waste and groundwater could indicate the potential for these compounds to migrate into any structures that are incorporated into the Site re-use concept.

As previously noted, the identification of COPCs in each medium will be presented within the Management Area-specific work plans. This interim effort will promote agreement on the basis of the risk assessment and expedite the regulatory review process. It should be noted that where constituents cannot be eliminated in the screening evaluation due to detection limits that are greater than the selected screening level, these constituents will be retained through the quantitative risk assessment, if warranted, on a case-by-case basis. These cases will be specifically discussed in the Management Area-specific work plans.

4.3

EXPOSURE ASSESSMENT

The exposure assessment evaluates the likelihood, magnitude and frequency of exposure to the COPCs, and identifies pathways and routes by which human receptors may be exposed to these constituents. The specific steps involved in the exposure assessment include the following:

- Characterization of Exposure Setting;
- Identification of Exposure Pathways;
- Development of Exposure Scenarios; and,
- Estimation of Exposure Point Concentrations.

The physical characteristics of the Site are examined to identify pathways by which human receptors may be exposed to constituents at the Site. Exposure scenarios are developed based on demographics, land use, and general human behavior patterns. Intake factors will be subsequently developed for the identified receptor populations under the defined conditions of exposure. Following the development of exposure scenarios and calculation of intakes, exposure point concentrations will be estimated. The intake factors and exposure point concentrations are used in the succeeding steps of the risk

assessment to quantitatively characterize the potential risks associated with the defined exposure scenarios.

4.3.1

Description of the Physical Setting

As discussed previously, the Site consists of upland, closed waste disposal areas, lowland wetland areas and surface waters; i.e., Herring Run, Moores Run, and Redhouse Run. With respect to the potential for human health contact with constituents released from the Site, the study area is currently predominantly vegetated with small trees, scrub brush, and wetland vegetation which could minimize direct contact exposures. Further, there are no paved roads and limited structures throughout the entire study area. However, the Site is not currently secure with fencing to restrict access, and there is evidence of regular trespassing. In the vicinity of the I-95 overpass, trails created by recreational vehicles, including all-terrain vehicles (ATVs) and automobiles/trucks, are clearly visible. These vehicles access Source Area 1 by fording Herring Run. In addition to limited direct vehicular access, the property is densely forested or vegetated with wetlands plants, which appears to further limit casual trespassing.

Approximately 32% of the study area is covered by surface water, wetland, or lowland within the 100-year floodplain. Accordingly, this sector of the study area will likely remain undeveloped under any re-use plan for the Site. The presence of surface waters and wetlands across the Site near mean sea level elevation also indicates that the groundwater table is shallow, expecting to occur within 20 feet of the ground surface with the exception of the area along I-95 where relocated waste has been re-disposed in five mounds during the construction of the access ramps.

The Human Health Conceptual Site Model (CSM) was presented in the PRE and will be refined, if warranted, for the Management Area-specific risk assessment work plans. The primary transport pathways presented in the CSM are further evaluated herein and will be iteratively refined throughout the ensuing Site investigation and risk assessment process. Accordingly, the potential contaminant transport pathways include the following:

- Waste materials in direct contact with the surface-water and groundwater;
- Surface-water run-off from the Site during and after precipitation events;
- Indirect contact with waste materials through groundwater discharge into the adjoining surface-water bodies;
- Direct exposure through groundwater usage, if any;
- Direct exposure to surface and subsurface waste materials;

- Vapor emissions from buried waste at the Site that migrate from the subsurface to the atmosphere, and if the Site is actively re-used, could potentially enter future Site buildings; and,
- Constituent uptake; e.g., PCBs, dioxins and potential bioaccumulation into edible fish tissue.

From these potential contaminant transport pathways, human exposure pathways for the Site will be evaluated. The following section describes the plausible human receptor populations that may frequent the Site and the potential pathways of exposure if contact is made with the potentially affected media.

4.3.2 *Identification of Potentially-Exposed Populations*

The identification of potential human receptors is based on several factors, including local land use and groundwater usage. This information will be the basis to identify individuals working and/or engaging in activities on the Site, both currently and potentially in the future.

The ultimate use of the Site is critical to the identification of human receptors and plausible exposure. As previously discussed in the IDGA (Appendix A to the ASAO SOW) and subsequently in Section 7.0, portions of the Site may be commercially developed while other portions may not, remaining as ecological preservation areas. Thus, considering all potential human receptor populations which may frequent the Site and the anticipated pathways of exposure by which the receptors could contact each medium, the plausible receptors include:

4.3.2.1 *Developable Land*

- Construction/utility workers,
- Commercial workers, and
- Trespassers/visitors.

In addition, residential exposure to groundwater will be considered to provide an evaluation of the worst-case scenario. For each of these potentially-exposed populations, potential exposure pathways are described in Section 4.3.3.

4.3.2.2 *Non-Developable Land*

- Recreational users (adult and child receptors), and
- Trespassers/visitors.

For each of these potentially-exposed populations, potential exposure pathways are described in the following section.

4.3.3

Identification of Exposure Pathways

The initial step is to identify the exposure pathways to be evaluated in the risk assessment. To qualify for evaluation, a pathway must include the following four elements:

- A source and mechanism of constituent release to the environment;
- A transport medium by which the released constituent may reach a receptor (e.g., groundwater);
- A point of potential contact by the human receptor with the contaminated medium (e.g., an individual accesses the Site and contacts the contaminated medium); and,
- An exposure route (e.g., ingestion, dermal contact, inhalation).

Considering each of the above elements, each sampled medium may be considered a potential transport medium for contaminant migration in the risk assessment. Potential receptors may contact constituents in soils and groundwater through ingestion, dermal contact and/or inhalation. These media may be contacted directly, or through a secondary exposure medium such as the atmosphere. The identification of exposure pathways to be evaluated in the HHRA will be presented in the Management Area-specific work plans.

Thus, considering all potential human receptor populations which may frequent the Site, and the anticipated pathways of exposure by which the receptors could contact each medium, the plausible receptor and exposure pathways include: 1) developable land; and, 2) non-developable land.

4.3.3.1

Developable Land

Plausible receptor and exposure pathways for developable land include the following scenarios:

- **Construction Worker Scenario.** Construction/utility workers may contact impacted media while conducting construction/utility maintenance activities, specifically those requiring subsurface disturbance. Construction/utility workers may contact exposed surface and subsurface soils (including buried wastes) via incidental ingestion, dermal contact and inhalation of vapors or particulate emissions in outdoor air. Likewise, contact with shallow groundwater while conducting subsurface activities (i.e., excavation/trenching activities) may occur, via incidental ingestion, dermal contact and inhalation of vapors. During restoration activities, construction/utility workers may contact (via ingestion and dermal contact) surface water and sediment present along the various streams located adjacent to the Site. Construction/utility worker exposures may occur under both short and long-term commercial exposure scenarios.

- **Commercial Worker Scenario.** Commercial workers may indirectly contact vapors (via inhalation) that may migrate from subsurface soil and/or groundwater into buildings that may be constructed as part of the re-use of the Site. Workers could also be exposed to constituents in surface soil via incidental ingestion, dermal contact and inhalation of vapors and released particulates. Such worker exposures may occur under long-term commercial exposure scenarios. Although potable water is supplied by the public water supply, one groundwater drinking well and other test wells have been reported within the area. The status of these wells will be confirmed and corresponding exposure scenarios, if any, considered.
- **Trespasser/Visitor Scenario.** Trespassers/visitors could be exposed to constituents via incidental ingestion, dermal contact and inhalation of vapors and particulates released from surface soils. Again, such exposure may occur under long-term exposure scenarios.
- **Residential Scenario.** It is not anticipated that residents will occupy the Site. Nonetheless, a hypothetical scenario will be evaluated for which residents may contact impacted groundwater via incidental ingestion, dermal contact and inhalation of vapors while bathing or showering. This scenario is evaluated to provide an estimate of risk for the worst-case scenario.

4.3.3.2

Non-Developable Land

Plausible receptor and exposure pathways for non-developable land include the following scenarios:

- **Recreational Scenario.** Recreational users (adult and child receptors) may contact COPCs in surface soil, surface water and sediment along the banks of various water bodies surrounding the Site while conducting activities such as wading, swimming, boating and fishing; fishing may, however, be limited to water bodies adequate to support recreational fisheries. For these receptors, the pathways and routes of exposures may include incidental ingestion and dermal contact with surface water and sediment. Long-term recreational exposures could also occur in preservation areas, particularly if used as nature preserves with hiking trails and similar opportunities which introduce human activity onto the Site.
- **Trespasser/Visitor Scenario.** Trespassers/visitors could be exposed to constituents via incidental ingestion, dermal contact and inhalation of vapors and particulates released from surface soils. Again, such exposures may occur under long-term exposure scenarios.

Appropriate intake parameters will be identified for each of the exposure scenarios discussed above. Values for the exposure parameters used generally reflect central tendency and reasonable maximum assumptions. Where USEPA guidance (USEPA, 1989) has specified intake parameters for the above-mentioned receptors, these values will be adopted. If specific inputs are not required, USEPA guidance and other sources will be utilized to develop reasonable exposure assumptions. This guidance will include the *Exposure Factors Handbook* (USEPA 1997), the *Standard Default Exposure Factors Guidance* (USEPA, 1991a), the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (USEPA, 2002a), *RAGS Part E Guidance* (USEPA, 2002) and the *Updated Dermal Exposure Assessment Guidance* (USEPA-Region III, 2003). The intake parameters will be used to calculate intake factors for each scenario according to the methods presented in *RAGS Part A* (USEPA, 1989) and the guidance documents enumerated above. Constituent-specific inputs will be required for many of the intake equations. As an example, the calculation of the soil inhalation intake requires the incorporation of a constituent-specific volatilization factor (VF). The VF defines the relationship between the concentration of a constituent in soil and the flux of the volatilized constituent to air. VFs will be developed using the methodology presented in the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (USEPA, 2002a). Constituent-specific particulate emission factors (PEF) will be derived for airborne particulates (e.g., semi-volatile organic and inorganic constituents) that are transported by air. PEFs will also be developed using the methodology presented in the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (USEPA, 2002a).

The estimation of dermal intake from constituents present in water requires the incorporation of a constituent-specific permeability constant that reflects the movement of a constituent across the skin and into the bloodstream. The estimation of dermal intake from constituents present in soil requires the incorporation of constituent-specific values for dermal absorption from soil. Constituent-specific dermal permeability constants and dermal absorption values used in this risk assessment, as well as other pertinent defaults with respect to assessing dermal risk, will be obtained from *RAGS Part E Guidance* (USEPA, 2002) and the *Updated Dermal Exposure Assessment Guidance* (USEPA Region III, 2003).

To estimate the potential risk to human health that may be posed by the presence of COPCs, it is first necessary to estimate the potential exposure dose of each COPC. The exposure dose will be estimated for each constituent via each exposure pathway by which the receptor is assumed to be exposed. Exposure dose equations combine the estimates of constituent concentrations in the

environmental medium of interest with assumptions regarding the type and magnitude of each receptor potential exposure to provide a numerical estimate of the exposure dose. The exposure dose is defined as the amount of COPC acquired by the receptor and is expressed in units of milligrams of COPC per kilogram of body weight per day (mg/kg-day).

Exposure doses are defined differently for potential carcinogenic and non-carcinogenic effects. The chronic average daily dose (CADD) is used to estimate a receptor potential intake from exposure to a COPC with non-carcinogenic effects. According to USEPA (1989a), the CADD should be calculated by averaging the dose over the period of time for which the receptor is assumed to be exposed. Therefore, the averaging period is the same as the exposure duration.

For COPCs with potential carcinogenic effects, however, the lifetime average daily dose (LADD) is employed to project potential exposures. In accordance with USEPA (1989a) guidance, the LADD is calculated by averaging exposure over a receptor assumed lifetime of 70 years. Therefore, the averaging period is the same as the receptor assumed lifetime.

The standardized equations presented in USEPA (1989a) will be used to estimate a receptor average daily dose, both lifetime and chronic.

4.3.5 *Estimation of Exposure Point Concentrations*

Exposure point concentrations (EPCs) can be projected by using either monitoring data alone or a combination of monitoring data and fate and transport modeling. Use of monitoring data alone is most often applicable where exposure involves direct contact with the monitored medium. However, where exposure points are spatially separate from the monitoring points (i.e., the source), fate and transport modeling may be necessary to predict EPCs (USEPA, 1989). A combination of both methods will be used in the Site risk assessment. It is expected that modeling will be used to estimate EPCs for constituents that may be present in the air and to estimate soil screening levels for constituents that may migrate from impacted soil into the groundwater. Models used to predict air concentrations will include procedures for deriving VFs and PEFs as described in Section 4.3.3. However, should the estimation of EPCs for other pathways become necessary, proposed modeling procedures (e.g., Johnson and Ettinger modeling of vapor intrusion into indoor and outdoor air) will be discussed in the Management Area-specific work plans.

The toxicity assessment will incorporate toxicity indices from sources identified in *Human Health Toxicity Values in Superfund Risk Assessments* (USEPA, 2003). Current toxicological indices; i.e., carcinogenic slope factors and reference doses, will be identified for each constituent of potential concern according to the following hierarchy:

- USEPA IRIS, an on-line toxicity data base updated monthly by USEPA;
- USEPA Provisional Toxicity Values, as provided in the USEPA-Region III RBC Table; and,
- Other Sources; e.g., the *Health Effects Assessment Summary Tables, HEAST* (USEPA) and other toxicological information sources, such as the ATSDR.

The following information will be tabulated for each carcinogenic COPC:

- The current carcinogenic slope factor (CSF) from IRIS or the other sources listed above;
- Weight-of-evidence narrative summary; and,
- Type of cancer for Class A carcinogens.

As recommended by the *Guidelines for Cancer Risk Assessment* (1996, 1999, and 2003), the USEPA is in the process of assessing the cancer risks for environmental constituents. As part of the process, a constituent-specific weight-of-evidence narrative is available, including the range of available evidence and a description of conditions associated with conclusions relative to a constituent hazard potential. Pertinent information will be summarized to characterize the uncertainty that may be associated with cancer potential for these constituents.

The following information will be tabulated for each non-carcinogenic COPC:

- Current reference doses (RfD); and,
- Target organ(s) and uncertainty factors.

Constituents without published toxicological indices will be evaluated and an appropriate surrogate value will be established. Selected surrogates will be provided in the Management Area-specific work plans for USEPA review.

Dose-response values are available for oral and inhalation exposures. Oral dose-response values will be used to evaluate dermal exposures provided appropriate dermal absorption values are available. COPCs will be evaluated quantitatively for the dermal exposure pathway. For inhalation pathways, reference concentrations (in units of milligrams/cubic meter [mg/m³]) will be converted to

reference doses, in units of milligrams/kilogram-day (mg/kg-day), for calculating risk of constituents with systemic effects.

Additional sources of toxicological information are presented below for specified constituents or constituent groups.

4.4.1 *Volatile and Semi-Volatile Organic Constituents*

Toxicity values for volatile and semi-volatile constituents will be obtained from the sources listed above, with the exception of polycyclic aromatic hydrocarbons (PAHs), as discussed below. No additional sources of toxicity information will be necessary to estimate risk should any of these constituents be detected in the Management Areas.

Polycyclic Aromatic Hydrocarbons

Seven (7) PAHs have been identified by USEPA as potentially carcinogenic. USEPA (2005) has developed an oral CSF for only one of these seven, namely benzo(a)pyrene. The potential carcinogenic effects associated with exposure to PAHs in environmental media will be assessed in accordance with the toxicity equivalence approach developed by USEPA (1993b). CSFs for other PAHs will be calculated by adjusting the benzo(a)pyrene CSF with the relative potency factor (USEPA, 1993b) that are specific for each of the PAHs. Relative potency factors are the same in concept as TEFs; i.e., fractions that equate the toxicity of each potentially-carcinogenic PAH to that of benzo(a)pyrene.

In addition, potentially carcinogenic PAHs will be evaluated for non-carcinogenic effects. However, RfDs are not available for the potentially carcinogenic PAHs. Therefore, surrogate RfDs will be applied based on structural similarities between the potentially carcinogenic PAHs and the non-carcinogenic PAHs.

4.4.2 *Metals*

With the exception of lead, the toxicity assessment for detected metals will be performed using values published by USEPA as referenced in the above-listed sources. Due to the uncertainty of the dose-response relationship between exposure to lead and biological effects, it is unclear whether lead exhibits a threshold response for noncarcinogenic effects. Thus, USEPA has not developed an RfD for lead. Similarly, a CSF has not yet been developed, although USEPA has classified lead as a B2 (probable human) carcinogen. Consequently, potential lead exposures cannot be evaluated using the traditional methods of risk assessment. The USEPA has developed an Integrated Exposure Uptake Biokinetic (IEUBK) model that correlates lead levels in the environment to blood

lead levels in children (USEPA, 2002g). Because children are more sensitive to the effects of lead than adults, only children will be evaluated for the trespasser and recreational scenarios for potential exposures to lead. If lead is identified as a COPC for the construction worker, the USEPA Adult Lead Model will be used (USEPA, 1996c). If lead is identified as a COPC in groundwater for the construction worker, the Bower's Model (Bowers, Beck and Karam, 1994), which assesses exposure to lead in water for adults, will be used. Lead is not expected to bioaccumulate into fish tissue and will therefore not be evaluated in the fish ingestion pathway.

4.4.3 *Pesticides/Herbicides*

Toxicity values for pesticides and herbicides will be obtained from the sources listed above. No additional sources of toxicity information will be necessary to estimate risk should any constituent within these groups be detected in the Management Areas.

4.4.4 *PCDDs, PCDFs and PCB Congeners*

The potential carcinogenic effects associated with exposure to polychlorinated dibenzodioxin (PCDD) and polychlorinated dibenzofuran (PCDF) congeners in environmental media will be assessed in accordance with the approach developed by USEPA (1989b) or final guidance available at the time the risk assessment is conducted. Risks will be calculated for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and the PCDD/PCDF congeners using the cancer slope factor for 2,3,7,8-TCDD listed in *HEAST* (USEPA, 1997b) and using toxic equivalency factors (TEFs). TEFs are fractions that equate the potential toxicity of each congener to that of 2,3,7,8-TCDD. The World Health Organization (WHO) (Van den Berg et al., 1998) has assigned a TEF to each of the PCDD/PCDF congeners. The concentration for each PCDD/PCDF congener will be multiplied by its TEF, resulting in a TCDD toxic equivalence concentration (TCDD-TEQ). The TCDD-TEQ values for each of the congeners will then be summed to derive a TCDD-TEQ for each sample. This TCDD-TEQ will be used to calculate summary statistics as described in Section 3.2 and EPCs as described in Section 4.3.4. The cancer slope factor for 2,3,7,8-TCDD will thereafter be used to calculate potential carcinogenic risks resulting from potential exposure to 2,3,7,8-TCDD, and the PCDD/PCDF congeners.

Similarly, of the 209 Polychlorinated Biphenyl (PCB) congeners, twelve (12) are currently considered to be "dioxin-like" because of their toxicity and certain features of their structure which are similar to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2378-TCDD). Under the WHO, the dioxin-like PCB congeners have been assigned 2378-TCDD Toxicity Equivalency Factors (TEFs), indicating their toxicity relative to 2378-TCDD, which itself has been assigned a TEF of 1.0.

Previously collected PCB data at the Site were reported as Aroclor-specific concentrations. Consequently, the historic PCB data cannot be combined with dioxin-like congener analyses. For risk assessment purposes, PCBs will be evaluated using the Aroclor-specific concentrations and also the PCB congener concentrations collected during the planned sampling. The WHO TEFs for "dioxin-like" compounds will be applied to Site data for use in the risk assessments.

4.5

RISK CHARACTERIZATION

In the final step of the risk assessment, the results of the exposure assessment; i.e., the calculated intakes, will be integrated with toxicity information to derive quantitative estimates of potential risk associated with the defined exposure scenarios. Risk projections will be calculated following the standard procedures defined in RAGS Part A (USEPA, 1989) and the results will be compared to levels of acceptable risk defined by USEPA (USEPA, 1990).

The incremental carcinogenic risk associated with exposure to COPCs detected at the Site will be calculated according to the following equation (USEPA, 1989):

$$\text{Incremental Carcinogenic Risk} = \text{Intake Factor} \times \text{EPC} \times \text{Cancer Slope Factor}$$

Under each defined scenario; e.g., direct contact with subsurface soil, projected risks for each carcinogenic constituent will be summed to derive a total risk associated with a specific route of exposure; e.g., ingestion. Similarly, risks from concurrent routes of exposure; i.e., ingestion, dermal contact, and inhalation, will also be summed to derive a total risk for a potentially exposed population under a specific scenario. If the calculated cancer risks exceed 1×10^{-2} , the "one-hit model" (e.g., $1 - \exp[-\text{Dose} \times \text{CSF}]$) will be used to appropriately estimate cancer risks. The resulting risk will be compared to the acceptable range of risk levels defined by USEPA (1990) in the National Oil and Hazardous Substances Pollution Contingency Plan.

Non-carcinogenic hazards will also be calculated for each COPC according to the methods described in *Risk Assessment Guidance for Superfund/Part A* (USEPA, 1989). Potential non-carcinogenic effects will be evaluated based on a comparison of constituent-specific chronic exposure doses with corresponding protective doses derived from health criteria. The result of this comparison is expressed as the hazard quotient (HQ):

$$\text{Hazard Quotient} = \frac{\text{Intake Factor} \times \text{EPC}}{\text{RfD}}$$

Hazard indices will be calculated as the sum of all appropriate hazard quotients to fully evaluate the potential non-carcinogenic hazard associated with a defined exposure. If necessary, hazard indices will be segregated according to target organ effects to more accurately assess the potential for adverse health effects to occur as a result of the defined conditions of exposure.

Current USEPA guidance (1995), clearly states in the *"Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions"* that Sites with a cumulative cancer risk of less than 1×10^{-4} , or a hazard index of less than 1.0 may not warrant remediation unless there are adverse environmental impacts. Conversely, a baseline risk level of less than 1×10^{-4} may be unacceptable due to Site-specific conditions and remedial action is warranted. However, the guidance specifically states that "the upper boundary of the risk range is not a discrete line at 1×10^{-4} ; although, USEPA generally uses 1×10^{-4} in making risk management decisions. A specific estimate around 1×10^{-4} may be considered acceptable if justified based on Site-specific conditions".

4.6

UNCERTAINTY ANALYSIS

The HHRA will present a qualitative and quantitative discussion of the uncertainties associated with each step of the risk assessment process and an evaluation of the significance of those uncertainties. An uncertainty analysis is an integral part of any risk assessment in that it enhances evaluations which shape subsequent risk management decisions. This discussion will include an evaluation of the uncertainties associated with the risk assessment process itself as well as the specific assumptions used in developing the risk assessment.

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Appendix E
Standard Operating Procedures

APPENDIX E

Standard Operating Procedures

68th Street Landfill Site Rosedale, Maryland

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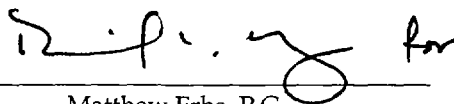
June 18, 2007

Standard Operating Procedures

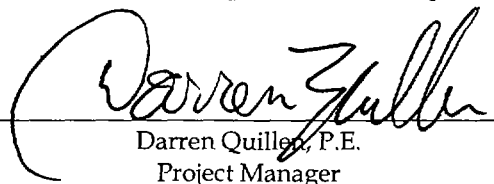
68th Street Landfill Site
Rosedale, Maryland

June 18, 2007

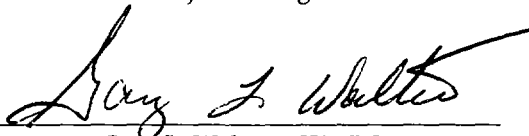
ERM Project No.: 0049608



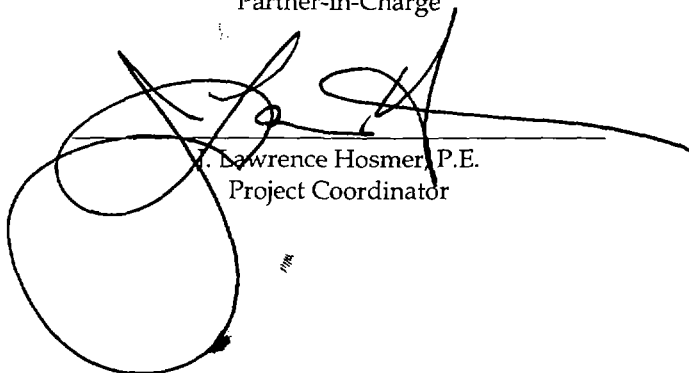
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LIST OF STANDARD OPERATING PROCEDURES (SOP)

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SOP 6801	SOIL BORING INSTALLATION USING HAND AUGERING
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SOP 6804	SOIL BORING, MONITORING WELL, AND PIEZOMETER ABANDONMENT
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SOP 6806	MONITORING WELL AND PIEZOMETER INSTALLATION
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LIST OF STANDARD OPERATING PROCEDURES (SOP)

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SOP 6828	FIELD NOTEBOOK
SOP 6830	AQUIFER TESTS - SLUG TESTS

SOP-6800
STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING HOLLOW STEM AUGERS

1.0 PURPOSE

The purpose of this SOP is to document the techniques for advancing hollow-stem augers in unconsolidated materials to collect geotechnical and hydrogeologic data and to install ground-water monitoring wells, piezometers, ground-water extraction wells, sparging wells, and soil vapor probes. Hollow stem auger drilling equipment (and split spoon sampling equipment) will be used in areas of the site that require a large diameter monitoring well or where subsurface conditions create refusal of direct-push drilling equipment.

2.0 EQUIPMENT AND MATERIALS

The driller shall provide a drilling rig with hollow-stem augers appropriate for the tasks requested by the project manager. The inside diameter (I.D.) of the hollow-stem augers will be specified in the work plan or project operation plan. The following equipment will be required:

- Field book;
- Digital camera;
- Measuring tape or ruler;
- Water level meter;
- Drilling rig with appropriate drilling capacity;
- Drill rods, minimum size equivalent to the "A" rod, with an outside diameter (O.D.) of 1-5/8 inches and an I.D. of 1-1/8 inches;
- Hollow-stem augers;
- Hollow-stem auger center plug;
- Drive hammer, 140 pounds (\pm 5 pounds);
- 18- or 24-inch-long split-spoon barrel samplers or five-foot length continuous samplers;
- Split spoon fringer baskets,
- Thin-walled Shelby tubes;
- Tri-cone roller;
- Water tank and pump;

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STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING HOLLOW STEM AUGERS

- Air monitoring/LEL meter;
- Air monitoring/PID meter;
- Steam cleaner, 5-gallon buckets, brushes, and non-phosphate detergent and other decontamination equipment as specified in SOP No. 6819; and
- Site-specific Health & Safety Plan (HASP).

In addition, the drilling contractor will provide the following equipment if requested or necessary:

- Auger finger baskets;
- steel bailer;
- Drive hammer, 300 pounds (\pm 5 pounds); and
- Roller bit.

3.0

PROCEDURES

The completion depth will be based on field observations and sample analysis (i.e., the purpose of the boring). In the event that refusal is encountered prior to completing a boring to the target depth, the boring location may be offset approximately 5 to 10 feet from the original location, and a second attempt will be made to reach the target depth. If auger refusal is encountered at the initial offset location, no further attempts will be made to complete the boring.

The boring will be installed by rotating the hollow-stem augers to the desired depth to collect soil samples or install a well, piezometer, or probe. While drilling, the hollow-stem auger center plug and drill rods will be inserted in the auger stem to minimize soil cuttings from entering the augers. Waste soil/overburdened material from drilling will be properly disposed of as directed by the Project Manager.

Soil samples will be collected by drilling to the top of the desired sampling interval and advancing a split spoon or Shelby tube sampler through the lead auger into undisturbed soil/overburden material. Split spoon samples will be collected in accordance with ASTM-D-1586, and Shelby tube samples will be collected in accordance with ASTM-D-1587. Alternatively, five-foot continuous samplers can be advanced as the augers are advanced. The sampler will be retrieved following each five-foot auger run. Description of soil samples will be logged in the field and observations recorded in a bound field notebook, as described in SOP Nos. 6805 and 6828, respectively.

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STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING HOLLOW STEM AUGERS

The driller will be prepared to minimize the effects of heaving sands during drilling operations by using auger finger baskets in place of a center plug, or by removing heaving sand from the augers with a steel bailer. Potable water will be added to the augers to control heave only if approved by the Project Manager. The Project Manager must approve any other methods for controlling heaving sands.

If an obstruction is encountered, the driller will attempt to penetrate the obstruction using the tri-cone roller bit, coring device, or other acceptable equipment as directed by the project manager. If attempts to penetrate the obstruction are unsuccessful, the boring will be decommissioned in accordance with SOP No. 6804, and reinstalled at an upgradient location.

Hollow-stem augering will be employed without the use of drilling fluids unless approved by the Project Manager. When water is used in the drilling operations, it will not be recirculated into the boring unless approved by the Project Manager. Water produced from this operation will be properly contained and disposed of as directed by the Project Manager. If a well, piezometer, or probe is not installed, each boring will be decommissioned in accordance with SOP No. 6804.

Soil samples will be screened in the field with an organic vapor analyzer (e.g., a photoionization detector, or PID) using the procedure described in SOP No. 6803.

If soil samples are collected, each will be properly labeled and immediately placed in a cooler with ice or ice packs to maintain the proper temperature for shipping samples to the laboratory. Samples will be labeled and handled in accordance with the requirements described in SOP No. 6827. Requirements for sample documentation and handling are also presented in SOP No. 6826.

4.0 DOCUMENTATION

The details of the boring operations will be recorded on boring logs, which will contain all pertinent data. Any deviations from this SOP and the reason for the deviation shall be documented.

5.0 SPECIAL NOTES

Hollow-stem augering is generally the preferred technique for performing soil investigations and well/piezometer installations. However, certain physical site

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STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING HOLLOW STEM AUGERS

characteristics may preclude use of this technique. These characteristics include depth to ground water, soil characteristics (e.g., heaving sands) and spatial limitations for drilling equipment. In addition, hollow-stem augering may cause excessive smearing of the boring in some clayey soils. The smearing effect may tend to reduce hydraulic communication between saturated zones and the screened intervals of monitoring wells and piezometers. Consequently, additional well development may be required to remove the smear zone.

To monitor for fire and explosive hazard purposes, a Lower Explosive Limit (LEL) meter and a photoionization detector PID will be used in conjunction to monitor the air in the vicinity of the operator breathing space during drilling activities following the action level protocol established in the HASP (Section 8.0).

6.0

REFERENCES

ASTM-D-1452, Standard Practice for Soil Investigation and Sampling by Auger Borings.

ASTM D-1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM D-1587, Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.

ASTM D-5784, Guide for Use of Hollow-Stem Augers for Geo-environmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices.

SOP No. 6803: Soil Screening with a PID.

SOP No. 6804: Backfill Soil Borings.

SOP No. 6805: Description of Soils.

SOP No. 6808: Containment of Investigation-Derived Wastes.

SOP No. 6814: Water Level Measurements.

SOP No. 6819: Decontamination of Sampling Equipment.

SOP-6800
STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING HOLLOW STEM AUGERS

SOP No. 6826: Chain-of Custody Requirements.

SOP No. 6827: Packaging and Shipping Requirements.

SOP No. 6828: Field Notebook- General.

SOP-6801
STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING HAND AUGERS

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used to install soil borings using a hand auger. Soil boring activities will be conducted in support of geotechnical analysis, existing landfill cover surveys, monitoring well and piezometer installation, and soil sampling activities. Hand auger samples will be collected from areas of the site that require soil sampling or descriptions of the subsurface that may be inaccessible to direct-push or hollow stem auger drill rigs.

2.0 EQUIPMENT AND MATERIALS

The following equipment will be required:

- Spade/shovel or bucket-auger;
- Field book;
- Digital camera;
- Measuring tape or ruler;
- Decontamination equipment (SOP No. 6819); and
- Site-specific Health & Safety Plan (HASP).

3.0 PROCEDURES

The completion depth will be based on field observations and sample analysis (i.e., the purpose of the boring). In the event that refusal is encountered prior to completing a boring to the target depth, the boring location may be offset approximately 5 to 10 feet from the original location, and a second attempt will be made to reach the target depth. If auger refusal is encountered at the initial offset location, no further attempts will be made to complete the boring.

Soil samples will be collected continuously from the ground surface to the final depth of each boring using hand auger methods. Descriptions of the soil samples will be logged in the field, and observations recorded in a bound field book (SOP No. 6828), as described in SOP 6805. Soil samples may be screened in the field with an organic vapor analyzer (e.g., a photoionization detector, or PID) using the procedure described in SOP No. 6803.

SOP-6801
STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING HAND AUGERS

If soil samples are collected, each will be properly labeled and immediately placed in a cooler with ice or ice packs to maintain the proper temperature for shipping samples to the laboratory. Samples will be labeled and handled in accordance with the requirements described in SOP No. 6827. Requirements for sample documentation and handling are also presented in SOP No. 6826.

Upon completion of each soil boring, the boring will be backfilled with soil cuttings to within approximately one foot of the existing grade. The remaining one foot of each boring will be backfilled to the ground surface with a cement/bentonite mixture.

4.0 DOCUMENTATION

As discussed in SOP 6803, a field book will be on-hand during the boring process. Field observations will be recorded in the field book and the soil boring will be logged following SOP No. 6805.

5.0 SPECIAL NOTES

Certain site characteristics may prevent the use of hand augers for the completion of soil borings.

6.0 REFERENCES

SOP No. 6803: Soil Screening with a PID.

SOP No. 6805: Description of Soils.

SOP No. 6808: Containment of Investigation-Derived Wastes.

SOP No. 6814: Water Level Measurements.

SOP No. 6819: Decontamination of Sampling Equipment.

SOP No. 6826: Chain-of Custody Requirements.

SOP No. 6827: Packaging and Shipping Requirements.

SOP No. 6828: Field Notebook- General.

SOP-6802
STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING THE DIRECT PUSH TECHNIQUE

1.0 PURPOSE

The purpose of this SOP is to document the procedures to advance direct push samplers in unconsolidated material to install small diameter monitoring wells, injection points, soil-gas probes, or to collect soil samples for chemical and geotechnical analyses. Direct-push samples will be collected from areas that do not require installation of a large diameter monitoring well and are accessible to either a track-mounted or truck-mounted drill rig.

2.0 EQUIPMENT AND MATERIALS

The drilling contractor will provide equipment capable of advancing direct-push samplers to required depths. In addition, the following equipment will be required:

- Drive rods/Dual Tube Sampling System;
- Utility knife (for opening liners) and stainless steel sampling knives for collecting soil samples;
- Field book;
- Digital camera;
- Measuring tape or ruler;
- Single-use acetate sample collection liners;
- Air monitoring/LEL meter;
- Air monitoring/PID meter;
- Decontamination materials consisting of clean potable and distilled water, a steam cleaner, brushes, and non phosphate detergent (as described in SOP No. 6819); and
- Site-specific Health & Safety Plan (HASP).

SOP-6802
STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING THE DIRECT PUSH TECHNIQUE

3.0 PROCEDURES

The completion depth will be based on field observations and sample analysis (i.e., the purpose of the boring). In the event that refusal is encountered prior to completing a boring to the target depth, the boring location may be offset approximately 5 to 10 feet from the original location, and a second attempt will be made to reach the target depth. If refusal is encountered at the initial offset location, no further attempts will be made to complete the boring.

The Dual Tube Sampling System allows soil sampling to progress while simultaneously casing-off the borehole. This prevents cave-in and reduces the potential to drag down contaminants from upper zones. Direct push can be conducted without the Dual Tube sampling system; however, the method should be conducted with caution to prevent cross contamination.

First, a clean acetate liner is inserted into the decontaminated sampler. The sampler is then attached to the drive head on the direct-push drilling rig and is hydraulically pushed/driven to the desired depth (generally, the samplers are pushed in two or four foot intervals). The sampler is then pulled from the boring using the drilling rig, opened, and the acetate liner is removed.

The acetate liner is usually easy to remove from the sampler, but occasionally, especially when drilling through fill material or granular soils, sand or fine gravel particles may become wedged between the liner and the inside surface of the sampler, making removal of the acetate liner and sampler difficult. If this occurs, the best way to remove the acetate liner is to gently tap the sampler and pull the acetate liner from the sampler with pliers. Attempting to push the acetate liner and sample out of the macro-core with a drive rod or similar object may deform or cross-contaminate the soil sample.

The acetate liners are to be opened by placing them on a level, stable surface, and cutting them lengthwise with a utility knife. Two cuts should be made so that the upper half of the liner can be removed for logging and soil sampling and the lower portion of the liner remains in place to protect the soil sample from cross-contamination.

The boring is advanced by adding sections of drive rods to the sampler and retrieving the sampler after each sample is collected. A decontaminated sampler with a new acetate liner shall be used for each consecutive sample; decontamination of the drive rods between samples is not necessary. Most samplers are equipped with a tip which helps prevent the introduction of material from the sides of the open boring, caved materials, or heaved materials

SOP-6802
STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING THE DIRECT PUSH TECHNIQUE

into the sampler. The tip is sometimes referred to as a "piston tip" and is usually retrievable (the tip is pushed to the top of the inside of the acetate liner as the sample is collected). The tip shall be used for each sample interval except for the initial (ground surface) sample. Please note that use of the tips will not necessarily prevent the inclusion of caved or heaved soil at the top of the samples, so careful inspection and description of the soil sample is very important.

If an obstruction is encountered which cannot be penetrated during drilling, the direct-push boring will be decommissioned as described, in Section 3.2 below. Any unused soil samples or waste material (including acetate liners and sampling gloves) will be properly stored consistent with SOP No. 6808. At the discretion of the Project Manager, soil may be separated from other waste materials such as liners, gloves, etc. The segregated soil may be stored in drums or covered with plastic consistent with SOP No. 6808.

3.1 SOIL LOGGING

The following soil logging procedures shall be followed when using direct-push methods:

1. Generally assume (unless you have a technically-defensible reason to believe otherwise) the top of the soil sample in the acetate liner corresponds to the top of the sample interval. For example, if you sample from 4.0 to 8.0 feet and recover 2.5 feet of soil sample, the length of soil recovered is from 4.0 feet to 6.5 feet. If this is not an adequate length or volume of soil for your sampling purposes, the project manager shall be consulted as to whether or not the installation of an offset boring to collect additional soil sample(s) is appropriate. Note that the soil column may be compressed by the advancement of the sampling equipment. If not observed directly by the logger, always instruct the driller to indicate which end of the acetate liner is the top of the sample for your reference.
2. After each direct-push sample is retrieved, the total depth of the boring and water level should be checked with a water level indicator or an interface probe. Measuring the total depth will evaluate the amount of boring cave or heave and help to determine what portion of the next sample may be caved or heaved material as opposed to in-place soil. This heaving and caving problem is minimized by the Dual Tube Sampling System. Evaluating the presence and depth to ground water is important

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STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING THE DIRECT PUSH TECHNIQUE

because partial soil sample recovery may preclude the observation and description of wet or saturated soil intervals. Furthermore, the identification of the uppermost saturated zone is critical to the selection of soil samples for chemical analyses. Water level and interface measurements shall be collected using a method consistent with SOP No. 6814.

3. Before filling soil sample jars, split the entire sample lengthwise with a decontaminated knife to evaluate what portion of the sample may be caved materials or boring heave. Clayey soils, especially these at depths below twelve feet, may tend to swell inward after the sampler is removed. When the sampler is inserted into the boring to collect the next consecutive sample, swelled clay from the sides of the boring may collect in the sampler. This material may appear to be in-place soil when the acetate liner is opened. (Please note: swelled clayey soils, caved materials, or heave may enter the sampler even if a tip is used.)

Description of soil samples will be logged in the field and observations recorded in a bound field notebook, as described in SOP No. 6805 and 6828, respectively. Descriptions of the soil samples will be logged in the field, and observations recorded in a bound field book (SOP No. 6828), as described in SOP 6805. Soil samples may be screened in the field with an organic vapor analyzer (e.g., a photoionization detector, or PID) using the procedure described in SOP No. 6803.

If soil samples are collected, each will be properly labeled and immediately placed in a cooler with ice or ice packs to maintain the proper temperature for shipping samples to the laboratory. Samples will be labeled and handled in accordance with the requirements described in SOP No. 6827. Requirements for sample documentation and handling are also presented in SOP No. 6826.

3.2

DECOMMISSIONING THE BORING

Direct-push borings will be decommissioned using granular bentonite or bentonite chips. The dry bentonite will be slowly poured into the boring and will be hydrated with potable water as it is installed. Due to the small diameter of direct-push borings (2 inches or less), and also to the fact that most direct-push borings quickly begin to cave or heave inward upon completion, decommissioning with grout slurry through tremie pipes or hoses is not practicable.

SOP-6802
STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING THE DIRECT PUSH TECHNIQUE

4.0 DOCUMENTATION

The details of the boring and sampling operations will be recorded in boring logs. Any deviations from this SOP and the reason for the deviation shall be documented.

5.0 SPECIAL NOTES

To monitoring for fire and explosive hazard purposes a Lower Explosive Limit (LEL) meter and a PID will be used in conjunction to monitor the air in the vicinity of the operator's breathing space during drilling activities following the action level protocol established in the HASP (Section 8.0).

Certain site characteristics and circumstances may prevent the use of direct push technology. These characteristics and circumstances may include the following:

1. Shallow soils with coarse gravel, cobbles or boulders which may be difficult to penetrate;
2. Loose, saturated granular soils or soft, wet silty soils which are not retained well by the sampler (i.e., very poor sample recovery);
3. Limited access to specific sampling locations; and
4. Required sampling depths that may exceed the practical use of direct-push equipment, which are generally in the range of 20 – 30 feet in dense clay-rich soil.

6.0 REFERENCES

ASTM 6282-98 D: Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations.

SOP No. 6803: Soil Screening with a PID.

SOP No. 6805: Description of Soils.

SOP No. 6808: Containment of Investigation-Derived Wastes.

SOP No. 6814: Water Level Measurements.

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STANDARD OPERATING PROCEDURE
SOIL BORING INSTALLATION USING THE DIRECT PUSH TECHNIQUE

SOP No. 6819: Decontamination of Sampling Equipment.

SOP No. 6826: Chain-of Custody Requirements.

SOP No. 6827: Packaging and Shipping Requirements.

SOP No. 6828: Field Notebook- General.

SOP-6803
STANDARD OPERATING PROCEDURE
SOIL FIELD SCREENING WITH A PHOTOIONIZATION DETECTOR OR
FLAME IONIZATION DETECTOR

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that will be followed to perform headspace screening on soil and water samples using a photoionization detector (PID) or a flame ionization detector (FID).

2.0 EQUIPMENT AND MATERIALS

- PID equipped with the appropriate eV bulb, or FID, as determined in the project work plan or as determined by the Project Manager;
- Adequate supply of calibration gas;
- Adequate supply of hydrogen gas for the FID's flame fuel source;
- Clean glass jars with lids;
- 1 qt. Ziploc baggies or equivalent;
- Aluminum foil;
- Site-specific Health & Safety Plan (HASP).

3.0 PROCEDURES

The PID or FID will be calibrated in the field in accordance with the manufacturer's requirements. Calibration should be performed at a minimum interval of once per day, specifically at the beginning of each day. The time, date, and other pertinent calibration information (e.g., span setting, if appropriate) will be recorded in the field notebook and equipment calibration log.

When the sample (e.g., soil or water) is collected, it will be placed into the glass sample jar until the jar is approximately half full. The mouth of the jar will be sealed with clean aluminum foil and the lid placed on the jar so that the foil is sealed against the jar. The sample jar will be agitated for at least fifteen seconds, taking care to avoid piercing the foil seal. The sample will be allowed to develop for five to ten minutes in a warm area. The probe will be inserted through the foil seal and the maximum instrument response (which should occur after two to five seconds) will be recorded.

As an alternative, Zip-loc baggies or equivalents may be used to screen soil samples. The sample will be prepared in the same manner as with a glass jar.

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STANDARD OPERATING PROCEDURE
SOIL FIELD SCREENING WITH A PHOTOIONIZATION DETECTOR OR
FLAME IONIZATION DETECTOR

After the sample has developed, the probe will be inserted through a small opening in the upper portion of the baggie to obtain the maximum headspace reading. The opening should be immediately closed around the probe to minimize any dilution of the headspace vapor. The bag should not be squeezed during headspace measurement.

Special care will be taken to avoid inserting the probe directly into the sample (e.g., soil or water), thus preventing permanent damage to the instrument.

4.0 **DOCUMENTATION**

PID or FID readings and calibration data will be recorded in the equipment calibration log, and field notebook, or on an appropriate data sheet.

5.0 **SPECIAL NOTES**

Where feasible, use of the PID shall be avoided in conditions where meter response is affected by high humidity. In addition, a PID or FID must be accustomed to the atmosphere that will be measured (i.e., the instrument will not work properly after taking it from a heated car or building to a cool outdoors). The equipment should be allowed to equilibrate for approximately fifteen to thirty minutes before it is used.

FIDs are sensitive to methane. If methane gas is present or suspected, the sample must be screened with a charcoal filter and without the filter. The difference in results is the concentration of volatile organics present in the sample.

6.0 **REFERENCES**

None.

SOP-6804
STANDARD OPERATING PROCEDURE
SOIL BORING, MONITORING WELL AND PIEZOMETER ABANDONMENT

1.0 PURPOSE

This section documents the procedures for decommissioning borings, wells, or piezometers installed in soil/overburden material and bedrock. Decommissioning activities performed in Maryland should be completed in accordance with the applicable regulations set forth in Code of Maryland Regulations (COMAR) 26.04.04, as stated herein.

2.0 EQUIPMENT AND MATERIALS

The following equipment will be required:

- Field book;
- Digital camera;
- Measuring tape or ruler;
- Water level meter;
- Drilling rig with solid-stem augers, hollow-stem augers or drive/spin casing
- Sodium-bentonite slurry or cement/bentonite grout
- Concrete
- tremie pipe or hose;
- Water tank and pump;
- Steam cleaner, 5-gallon buckets, brushes, and non-phosphate detergent and other decontamination equipment as specified in SOP No. 6819; and
- Site-specific Health & Safety Plan (HASP).

3.0 PROCEDURES

3.1 GENERAL PROCEDURES

The following general procedures will be adhered to regardless of the type of boring, well or piezometer being decommissioned.

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Prior to decommissioning activities, the static water level and total depth of the boring, well, or piezometer will be measured and recorded using an interface probe or a water level indicator.

If a well or piezometer is being decommissioned, the drilling subcontractor will remove the protective casing/manhole and concrete pad after the static water level and total depth are recorded. Several methods may be used depending on whether the well has an aboveground protective casing or a flush mount (i.e., manhole) and in consideration of local, state and/or Site guidelines.

A field representative will observe all decommissioning activities and record all pertinent data on the appropriate field forms. All decommissioned borings, wells, or piezometers should be filled with grouting materials to within approximately three feet of the ground surface. The remainder of the boring should be filled with concrete, crushed stone or soil depending on the surface conditions. In asphalt pavement areas, the Project Manager may direct that a three to four inch thick seal of asphalt be installed on top of a concrete seal. All decommissioned boring surface seals should be neatly installed, match the surrounding ground surface (if possible), and be flush with the surrounding ground surface.

3.2

PROCEDURES FOR DECOMMISSIONING OF BORINGS INSTALLED IN SOIL/OVERBURDEN MATERIALS

In general, the boring will be sealed with a sodium-bentonite slurry or a cement-bentonite grout. A tremie pipe will be lowered the bottom of the augers or casing to inject the slurry or grout. As the slurry or grout is pumped into the augers, it displaces any accumulated groundwater, providing a continuous grout seal. The augers or casing will be filled as necessary to maintain a continuous seal as auger/casing sections are pulled from the borings. The boring will be filled to within three feet of the ground surface with the slurry or grout. The slurry or grout will be allowed to settle and stabilize for approximately eight to twelve hours. After the stabilization period, additional grouting materials will be added if needed.

This technique should be used to decommission borings installed in noncohesive soils (sand and silts), saturated soils, borings which are greater than twenty-five feet deep, or borings which contain more than two feet of standing water. The augers/casing should not be removed from the ground prior to grouting.

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An alternative method of sealing some borings is to backfill the boring with sodium bentonite pellets or chips through the augers or casing. As the chips are installed and the auger/casing sections are removed, the pellets or chips should be hydrated with potable water. This technique must be approved by the Project Manager.

**3.3 *PROCEDURES FOR DECOMMISSIONING OF WELLS OR PIEZOMETERS
INSTALLED IN SOIL/OVERBURDEN MATERIALS***

In general, well/piezometer decommissioning will be performed with a drill rig and hollow stem augers as approved by the Project Manager. In accordance with COMAR 26.04.04.11 F (1) (d) for drilled wells, if it is not possible to remove the casing, the casing may be ripped or perforated to make certain that the sealing material fills all annular spaces and voids. After the protective casing/manhole and concrete pad have been removed, the well or piezometer will be removed using one of the following methods:

The riser and screen will be pulled from the ground using the hydraulic lift on the drilling rig. The grout bentonite seal, and sand pack materials will then be drilled out of the remaining boring using hollow stem augers with a minimum outside diameter equal to or greater than the diameter of the original boring.

If the riser and screen can not be pulled, or if the riser and screen breaks during the pulling attempt, then the riser and screen may be left in place, then filled with bentonite chips and hydrated. As stated in COMAR 26.04.04.11 E (1) (e), a bentonite clay mixture shall be composed of not less than 2 pounds of clay per gallon of water. Bentonite clay may not be used where it will come in contact with waters of a pH below 5.0 or total dissolved solids content greater than 1,000 mg/l or both.

A well in unconsolidated material in an unconfined ground water zone (Hydrogeologic Area 1) shall be filled and sealed by placing fill material in the well to the level of the water table, then filling the remainder of the well with sealing material. If the water table is at a depth greater than 40 feet, a minimum of 40 feet of sealing material shall be required, as required by COMAR 26.04.04.11 F (2) (b) (i).

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3.4 *PROCEDURES FOR DECOMMISSIONING OF BORINGS EXTENDING INTO BEDROCK*

The bedrock section of the borehole will be sealed off by slowly pouring sodium-bentonite pellets or chips to a depth of at least one foot above the bedrock surface. If augers or casing extend into bedrock, they will be raised as the pellets or chips are added. An alternative procedure for sealing off bedrock will be to tremie a sodium-bentonite slurry or cementbentonite grout into the boring to a depth of at least one-foot above the bedrock surface. A final alternative method will be to fill the bedrock boring with clean silica sand to a depth of one foot below the bedrock surface and install a seal of sodium-bentonite pellets or chips to a depth of one foot above the bedrock surface.

The boring above the bedrock surface will be sealed in accordance with the procedures explained in Section 3.1 and Section 3.2.

3.5 *PROCEDURES FOR DECOMMISSIONING WELLS OR PIEZOMETERS INSTALLED IN BEDROCK*

In general, bedrock well, piezometer decommissioning will be performed using a drilling rig with hollow stem augers and rotary drilling equipment (tri-cone roller bit, three inch O.D. drilling rods, and a water tank and pump or air compressor). After the protective casing/manhole and concrete pad have been removed in accordance with COMAR 26.04.04.11 F (1), the well or piezometer will be removed by using one of the following methods:

The driller will attempt to pull the riser and screen of the well/piezometer from the ground using the hydraulic lift on the drilling rig. Well materials (grout, bentonite seal, sand pack) in the portion of the boring above the bedrock surface will then be drilled out using hollow stem augers with a minimum outside diameter equal to or greater than the diameter of the original boring. Well materials in the bedrock portion of the boring may also be drilled out using the augers if the bedrock is soft or fractured enough to be penetrated. If the bedrock can not be penetrated using the hollow stem augers, then the well materials in the bedrock portion of the boring will be removed using a tri-cone roller bit with a minimum outside diameter equal or greater than the diameter of the original 2 This method is only recommended under circumstances where bedrock is relatively unfractured, well cemented, and/or exhibits low hydraulic conductivity. Also, this method should only be used at sites where potential analytical bias from slurry constituents migrating in ground water to nearby bedrock monitoring wells is not a concern.

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This method is recommended under circumstances where bedrock is highly fractured, loosely cemented, and/or exhibits high hydraulic conductivity, and there is concern about analytical bias from slurry constituents migrating in ground water to nearby bedrock monitoring wells. boring. Potable water or air may be used as the drilling fluid as directed by the Project Manager.

The driller will overdrill the soil/overburden portion of well/piezometer using appropriately-sized hollow stem augers and pull the riser and screen from the ground using the hydraulic lift on the drilling rig. The bedrock portion of the well/piezometer may also be overdrilled with hollow stem augers if possible. Otherwise, the well materials in the bedrock portion of the boring will be drilled out using a tri-cone roller bit as described above.

If the well/piezometer is constructed of PVC and the riser and screen can not be pulled or have broken, the well/piezometer can be drilled from the ground using the hollow stem augers equipped with the center plug and the tri-cone roller bit as described above.

In all cases, the hollow stem augers tri-cone roller bit, or other approved drilling equipment should be advanced approximately one foot below the bottom of the original boring to ensure all well materials are removed.

After all well/piezometer construction materials have been removed, the boring will be sealed in accordance with the procedures explained in Section 3.1 and Section 3.4, as well as those outlined by COMAR 26.04.04.11 F (1).

4.0 DOCUMENTATION

All pertinent data will be recorded on the appropriate field forms (boring logs or well decommissioning forms), including, but not limited to, the date, time, static water level and total depth, decommissioning method and equipment used and types and amounts of sealing materials used SOP No. 6828.

5.0 SPECIAL NOTES

Cement-bentonite grouts should not be used for decommissioning borings, wells, or piezometers at landfills. Sodium bentonite sealants should always be used at landfills. Calcium and magnesium are monitored as groundwater quality indicator parameters at many landfills, and calcium and magnesium ions

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released from cement-bentonite grout into groundwater could interfere with landfill groundwater monitoring systems.

Replacement or new soil borings, monitoring wells, or piezometers which are installed in the vicinity of decommissioned borings, well, or piezometers will be located approximately ten feet away and, to the extent feasible, hydraulically upgradient of the decommissioned location. This practice will help prevent any potential effects of the grouting materials on the quality of subsequent groundwater samples.

6.0 ***REFERENCES***

SOP No. 6808: Containment of Investigation-Derived Material.

SOP No. 6819: Decontamination of Sampling Equipment.

SOP No. 6828: Field Notebook- General.

COMAR Title 26, Subtitle 04, Chapter 04 – Well Construction

SOP-6805
STANDARD OPERATING PROCEDURE
DESCRIPTION OF SOILS

1.0 PURPOSE

This SOP summarizes specific procedures for characterizing the most critical soil properties, pursuant to appropriate ASTM standards, to be used to visually classify and describe soils in the field. These soil properties include: soil density or consistency (depending on soil type), soil color, textural classification, moisture content, and other selected physical properties.

2.0 EQUIPMENT AND MATERIALS

The following equipment will be required:

- Pocket penetrometer;
- ASTM D 2488-93 Standard Practice for Description and Identification of Soils (Visual- Manual Procedure);
- Knife or spatula;
- Field book;
- Digital camera;
- Measuring tape or rule; and
- Site-specific Health & Safety Plan (HASP).

3.0 PROCEDURES

In general, soil descriptions shall be written in the following format, using the procedures based upon the Unified Soil Classification System (USCS), USDA or Burmister Classification System as directed by the Project Manager to meet the project needs. Major components are shown in capital letters (e.g. SAND), as following example demonstrates: *hard brown silty CLAY with a trace of sand and gravel, moist, fractured*. Attached Figure 1 depicts soil characterization guidance charts for reference.

Soil characteristics that will be recorded based on a visual examination of the samples in the field are as follows:

1. Penetration resistance (i.e. density) based on blow counts or field tests.

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2. Soil type based on the USCS, USDA or Burmister Classification System;
3. Color;
4. Sphericity (i.e., angular vs. well rounded);
5. Stratification, when appropriate, using the following terms:
 - massive – thickness greater than 3.3 feet (1 meter),
 - bedded – thickness of 0.5 inches to 3.3 feet (1 centimeter to 1 meter),
 - laminated – thickness of 1 millimeter to 0.4 inches (1 centimeter);
6. Type and thickness of materials composing the engineered cap (i.e., fly ash layers);
7. Moisture (i.e., dry, moist, wet, saturated);
8. Depth at which water is encountered;
9. PID screening value (where appropriate);
10. Other distinguishing or notable features (e.g., presence of organic material, unusual colors, noticeable odors, any other unusual features or observations, etc.).

3.1 *PENETRATION RESISTANCE*
(DENSITY OR CONSISTENCY CLASSIFICATION)

The penetration resistance of soils is determined using blow-count (N-value) data or field tests, when available, and is a function of cohesiveness or non-cohesiveness as described in Tables 1 and 2 below. If blow count data are available, the Visual-Manual procedures shall be used for cohesive soils.

Soils are to be described in the field using flow-charts in Figures 1a, 1b and Figure 2 of ASTM D 2488. This visual manual procedure does not apply to non-cohesive soils. A cohesionless soil is one that, when unconfined, has little or no strength when air-dried and has little or no cohesion (shear strength) when submerged. A cohesive soil is one that, when unconfined, has considerable strength when air-dried and has significant cohesion when submerged. Additionally, per Note 15 of ASTM D 2488, textural classification may be further defined using percentages (by weight) of gravel, sand, and fines, as follows:

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- "trace" for constituents comprising 0-10 percent by volume,
- "little" for constituents comprising 11-20 percent by volume,
- "some" for 20-35 percent by volume, and
- "and" for 35-50 percent by volume;

3.2 SOIL COLOR

Color descriptions are to be made subjectively at the discretion of the field professional. Color can vary depending on moisture content; therefore, it is important to note moisture content when describing color (see Section 3.5 below). If the sample contains layers or patches (e.g., mottling) of varying colors, this should be noted and all representative colors are to be described. Color contrasts are commonly observed in lacustrine deposits where varves are present from seasonal depositional events.

Table 1. Density of Cohesionless Soils

N-Value Range	Density Adjective
0 -10	Loose
11- 20	Medium dense
21 - 30	Medium dense to dense
31 - 40	Dense
41 - 50	Dense to very dense
> 50	Very dense

Table 2. Consistency of Cohesive Soils

Description	Blow Counts	Blow Counts not Available
Very soft	< 2	Easily penetrated several inches by fist
Soft	2 - 4	Easily penetrated several inches by thumb
Medium stiff	4 - 8	Can be penetrated several inches by thumb with moderate effort

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Stiff	8 -15	Readily indented by thumb but penetrated only with great effort
Very stiff	16 - 30	Readily indented by thumbnail
Hard	>30	Indented by thumbnail
Very hard		Thumbnail will not indent soil

3.3 TEXTURAL CLASSIFICATION (AND PARTICLE-SIZE RANGES)

Particle size ranges defined by ASTM D 693 as follows:

- Boulders - Greater than 12 inches (305mm),
- Cobbles - 3 inches (76.2mm) to 12 inches (305mm),
- Coarse Gravel - 3/4 inches (19.05mm) to 3 inches (76.2mm),
- Fine Gravel - No. 4 -3/16 inches (4.75mm) to 3/4 inches (19.05mm),
- Coarse Sand - No. 10 (2.00mm) to No. 4 (4.75mm),
- Medium Sand - No. 40 (0.425mm) to No. 10 (2.00mm),
- Fine Sand - No. 200 (0.074mm) to No. 40 (0.425mm),
- Silt - 0.005mm to 0.074mm,
- Clay - Less than 0.005mm.

Textural composition of fines (particles < 0.074 mm) is determined by the degree to which fines exhibit plasticity (putty-like properties), as described in Table 3. If soil is non-plastic or only very slightly plastic, fines are considered to be primarily silt; however, if soil clearly exhibits plastic characteristics, fines are considered to be primarily clay.

Table 3. Criteria for Describing Plasticity

Description	Criteria
Non-plastic	A 1/8-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit. ^a

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Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

a. Plastic limit is defined as the water content (%) of a soil at the boundary between plastic and brittle states. The water content at this boundary is the water content at which soil can no longer be deformed by rolling into a 1/8- in. diameter thread without crumbling (ASTM 4318).

If wanted or required, Tables 4 through 7 can be used to describe soil dry strength, dilatancy, toughness, and group symbology, respectively.

Table 4. Criteria for Describing Dry Strength (from ASTM D 2488)

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling.
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very high	The dry specimen cannot be broken between the thumb and a hard surface.

Table 5. Criteria for Describing Dilatancy (from ASTM D 2488)

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

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Table 6. Criteria for Describing Toughness (from ASTM D 2488)

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

**Table 7. Identification of Inorganic Fine-Grained Soils from Manual Tests
(from ASTM D-2488)**

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

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In summary, and in terms of textural classification, the major soil constituent (> 50% by weight) is the principle noun, (i.e. gravel, sand, silt, or clay). The second major constituent is an adjective to the principle noun and lesser constituents, if present, and follows the noun. Do not use more than one adjective (i.e., modifier) to the principle noun. For example, if clay content within the fine-sized fraction is sufficient such that clay dominates soil properties (i.e., soil plasticity and other characteristics), clay becomes the principal noun and the other major soil constituent(s) become modifier(s); (e.g., silty clay). If present, other minor soil constituents (e.g., sand and gravel) may then be included in the description in accordance with the above particle-size ranges, (e.g., silty CLAY, trace of sand, little gravel). DO NOT use multiple modifiers as in this example where gravelly becomes the multiple modifier (e.g., gravelly silty CLAY with a trace of sand).

3.4 **GROUP SYMBOLS**

USCS group symbols (e.g., CL, ML, SM, GW, etc.), will not be used on field logs. However, if samples are analyzed in the laboratory and texturally classified according to the appropriate ASTM standard, then such group symbol(s) may then be entered onto the log for report/presentation purposes.

3.5 **MOISTURE CONTENT**

Moisture contents may be written as dry, moist or wet as described below:

- Dry - apparent absence of moisture, dusty, dry to touch,
- Moist - damp, but no visible water,
- Wet - visible free water, usually soil is below water table.

3.6 **OTHER PHYSICAL CHARACTERISTICS**

For description of physical soil properties other than density/consistency, color, texture, or moisture, see the following tables in ASTM D 2488 for the following parameters:

- Particle angularity or shape - Tables 1 or 2
- Soil reaction with hydrochloric acid (HCl) - Table 4

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- Strength of soil cementation - Table 6
- Structural criteria - Table 7

Other soil characteristics that should be noted and described, if observed, including: fractures, fracture fillings, laminations, varves, organic content, oxidation, mineral fillings, sorting, root holes, worm borrows, and any evidence of potential contamination such as odors or sheens.

3.7 ***SAMPLE-TYPE DESIGNATIONS:***

Methods by which soil samples are collected for analysis are to be abbreviated in the field notebook as follows:

- AS - Auger Sample - Directly from auger flight;
- BS - Miscellaneous Samples - Bottle or Bag;
- SP - Split Spoon Sample - ASTM D 1586-67;
- LS - Liner Sample (brass liners) liner inserts 3 or 6 inches in length;
- ST - Shelby Tube Sample - 3 inch diameter unless otherwise noted;
- PS - Piston Sample - 3 inch diameter unless otherwise noted;
- RC - Rock Core - NX core unless otherwise noted; and
- DP - Direct Push Sample - 4 foot Macro Core or 2 foot acetate-lined sampler.

4.0 ***DOCUMENTATION***

Sample identification will be documented in the field notebook (see SOP No.6828) and the soil boring log sheet (Attached).

5.0 ***SPECIAL NOTES***

It is important to measure the length of recovery when collecting soil samples with a split-spoon or similar device, preferably in tenths of a foot. It is assumed that if sample recovery is less than 100%, the portion of the sample that is missing is from the bottom of the sampling interval and NOT the top. For example, if the sampling interval is 6 to 8 feet and 1.5 feet of recovery is measured, it is assumed that the sample represents the interval from 6 to 7.5 feet.

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The description for the missing portion must be inferred based on the description above and below the missing interval.

6.0

REFERENCES

ASTM Standard D 653-96, "Standard Terminology Relating to Soil, Rock, and Contained Fluids," In: ASTM Standards on Environmental Sampling, Second Edition, 1997, Philadelphia, PA. Pages 920-954.

ASTM Standard D 1586-84 (Reapproved 1992), "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils," in: ASTM Standards on Environmental Sampling, Second Edition, 1997, Philadelphia, PA. Pages 141-145.

ASTM Standard D 2488-93, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)," In: ASTM Standards on Environmental Sampling, Second Edition, 1997, Philadelphia, PA. Pages 103-113.

ASTM Standard D 4318, "Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity index of Soils."

McCarthy, D.F., 1988, "Essentials of Soil Mechanics and Foundations: Basic Geotechnics," third edition, Prentice-Hall publishers, 614 pages.

Naval Facilities Engineering Command, 1986, "Soil Mechanics," Design Manual 7.01, Revalidated by change 1, September 1986.

SOP No. 6828: Field Notebook.

SOP No. 6803: Soil Screening with a PID.

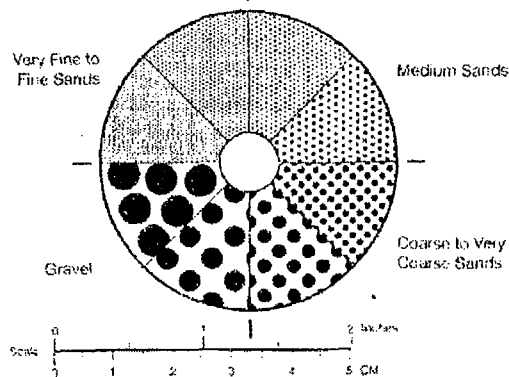
SOP No. 6808: Containment of Investigation-Derived Wastes.

SOP No. 6819: Decontamination of Sampling Equipment.

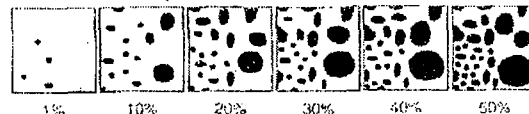
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Figure 1. Soil Characterization Guidance Charts

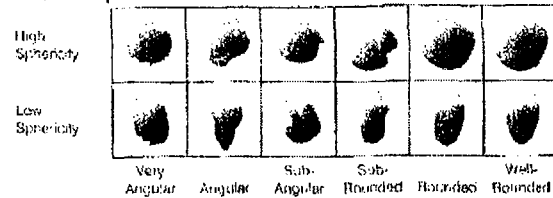
Graph for Determining Size of Particles



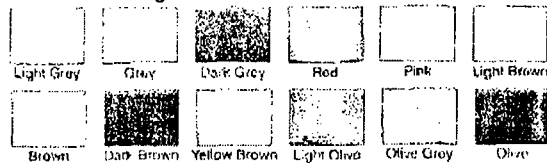
Particle Percent Composition Estimation



Particle Shapes



Soil Color Matching Chart



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Consistency - Cohesive Soils				
Term	SPT N Value Blows/12"	Thumb Penetration	Undrained Shear Strength, C_u Torvane (psf)	Unconfined Compressive Strength q_c Pocket Penetrometer (psf)
Very soft	< 4	Soil deforms under thumb pressure	< 500	< 500
Soft	4 - 15	Soil deforms under thumb pressure	500 - 1500	1000 - 3000
Medium stiff	15 - 30	Soil deforms under thumb pressure	1500 - 3000	3000 - 6000
Stiff	30 - 50	Soil deforms under thumb pressure	3000 - 6000	6000 - 12000
Very stiff	> 50	Soil deforms under thumb pressure	> 6000	> 12000

Density - Granular Soils

Term	SPT N Value Blows/12"	Relative Density %	Field Test
Very loose	< 4	< 20	Penetration by 1/2" rod pushed by hand
Loose	4 - 10	20 - 30	
Medium dense	10 - 30	30 - 60	Penetration by 1/2" rod with 5 lb hammer
Dense	30 - 50	60 - 90	
Very dense	> 50	90 - 100	Penetration by 1/2" rod with 10 lb hammer

Correlation for variations in grain size and blow counts should be applied as necessary (e.g. Table A (Holtz, 1951)).
* Blow counts equal the number of 60 lb hammer blows, dropped 30" required to drive a 2" split spoon every 6"

Grain Size Comparisons

Material	Fraction	Sieve Size	Grain Size	Approximate Scale Size
Clay		> 12"	> 300 mm	Longer than basketball
Coarse		1" - 12"	75 mm - 300 mm	Marble to baseball
Gravel	Coarse Sandwich Fine	3/4" - 3" 3/8" - 3/4" No. 4 - No. 20	19 mm - 75 mm 4.75 mm - 19 mm 75 mm - 4.75 mm	Baseball to golfball Compared to berries Thru to pea
Sand	Very Coarse Coarse Medium Fine Very fine	No. 10 - No. 4 No. 10 - No. 60 No. 40 - No. 60 No. 60 - No. 200 No. 200 - No. 425	4.75 mm - 4.75 mm 4.75 mm - 0.075 mm 0.075 mm - 0.075 mm 0.075 mm - 0.075 mm 0.075 mm - 0.075 mm	Pea to rock salt Flour to salt Flour to salt Flour to salt Flour to salt
Silt & Clay	See Descriptions of Fines	< No. 200	< 0.075 mm	Flour and kinder

Component Fractions

Term	Percent of Total Sample (by weight)
And	35 - 50
Fine	20 - 35
Little	10 - 20
Trace	< 10

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Soil/Rock Description

REQUIRED SOIL/ROCK DESCRIPTION

- Color
- Principal components (capital letters)
- Minor components (and, some, little, trace)
- Structure and bedding
- Field moisture condition
- Fill or geological origin, if known (in parenthesis after moisture condition, see example below)
- Unified Soil Classification System group symbol (soil only)
- Contacts when observed

SOIL DESCRIPTION COMPONENTS INCLUDED WHEN AVAILABLE

- | | |
|--|---|
| <ul style="list-style-type: none"> • Particle angularity/shape • Particle sizes • Density/consistency • Moisture content • Organic content • Hardness of coarse particles (Mohs hardness scale) • Plasticity of fines • Cohesiveness | <ul style="list-style-type: none"> • Pliability • Odors/discoloration • Mottling/staining • Weathering • Local name, if known • Items that may indicate age of deposit: archaeological artifacts, newspapers, etc. • Fill component description (concrete, clay, metal, tires, etc.) |
|--|---|

ROCK DESCRIPTION INCLUDED WHEN AVAILABLE

- | | |
|---|---|
| <ul style="list-style-type: none"> • Friability/fragility • Thickness • Particle angularity/shape • Particle sizes • Rock Quality Designation (RQD) • Rock type • Additional petrographic information • Texture | <ul style="list-style-type: none"> • Strength of intact rock • Weathered state • Voids • Description of discontinuities and fillings • Formation name (if known) • Water content • Odors/discoloration |
|---|---|

SOIL DESCRIPTION EXAMPLE:

2.5' - 4.5' stiff dark gray low plasticity Clay and Silt, laminated with some light brown silt, some fine sand (Holst, Glacio-lacustrine) CL

ROCK DESCRIPTION EXAMPLE:

4.5' - 12.0' reddish brown fine to coarse Sandstone, little angular gravel, trace silt

Unified Soil Classification System				
Major Divisions			Group Symbols	Typical Names
Coarse-Grained Soils. More than half of materials is larger than No. 200 sieve size.	Sand. More than half of coarse fraction is smaller than No. 4 sieve size	Clean gravels	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines	GM	Silty gravels, gravel-sand silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures
	Gravels. More than half of coarse fraction is larger than No. 4 sieve size	Clean sands	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils. More than half of materials is smaller than No. 200 sieve size.	Silt and Clay	Low Liquid Limit	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silt, with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity
		High Liquid Limit	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clay of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts
	High organic soils		Pe	Peat and other highly organic silts

Note: Well graded = poorly sorted and vice versa

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STANDARD OPERATING PROCEDURE
DESCRIPTION OF SOILS

Percentage of Sand Sizes in Subclasses of Sand, Loamy Sand, and Sandy Loam Basic Textural Classes as Defined by the U.S. Department of Agriculture.						
Basic soil class	Subclass	Soil separates				
		Very coarse sand, 2.0 - 1.0 mm	Coarse sand, 1.0 - 0.5 mm	Medium sand, 0.5 - 0.25 mm	Fine sand, 0.25 - 0.1 mm	Very fine sand 0.1 - 0.05 mm
Sands	Coarse sand	25% or more		Less than 50%	Less than 50%	Less than 50%
	Sand	25% or more			Less than 50%	Less than 50%
	Fine sand			- or -	50% or more	Less than 50%
		Less than 25%				
	Very fine sand					50% or more
Loamy sands	Loamy coarse sand	25% or more		Less than 50%	Less than 50%	Less than 50%
	Loamy sand	25% or more			Less than 50%	Less than 50%
	Loamy fine sand			- or -	50% or more	Less than 50%
		Less than 25%				
	Loamy very fine sand					50% or more
Sandy loams	Coarse sandy loam	25% or more		Less than 50%	Less than 50%	Less than 50%
	Sandy loam	Less than 25%	75% or more			Less than 50%
	Fine sandy loam			- or -	30% or more	Less than 50%
		Between 15 and 30%				
	Very fine sandy loam			- or -		30% or more
		Less than 15%			More than 40%	

* Half of fine sand and very fine sand must be very fine sand.

ASTM General Classification Information	
Term	Criteria
Dry Moist Wet	Field Moisture Condition Absence of moisture - dusty - dry to the touch Damp - but not visible water Visible free water, usually soil is below the water table.
Angular Subangular Subrounded Rounded	Angularity of Coarse grained Particles Particles have sharp edges and relatively planar sides with unpolished surfaces. Particles are similar in angularity but have rounded edges. Particles have nearly planar sides but have well rounded corners and edges. Particles have smoothly curved sides and no edges.
Flat Elongated Flat & Elongated	Particle Shape Particles with width/length ratio > 3 Particles with length/width > 3. Particles meeting criteria for both flat and elongated.
Weak Moderate Strong	Cementation Crumbles or breaks with banding or little finger pressure. Crumbles or breaks with considerable to finger pressure. Will not crumble with finger pressure.
None Weak Strong	Reaction with HCL Solution No visible reaction Some reaction with bubbles forming slowly. Violent reaction with bubbles forming immediately.
None Slow Rapid	Dilatancy No visible change when shaken or squeezed. Water appears slowly on the surface of soil during shaking and does not disappear or disappears slowly when squeezed. Water appears quickly on surface of soil during shaking and disappears quickly when squeezed.
Nonplastic Low Medium High	Plasticity A 127 ft thread cannot be rolled at any moisture content. Thread can barely be rolled and hard curved ball formed when drier than plastic limit. Thread is easy to roll and nearly spherical plastic limit. Thread cannot be rolled after reaching plastic limit. Lump crumbles when drier than plastic limit. Takes considerable time and rolling to reach plastic limit. Thread can be rolled several times after reaching plastic limit. Lump can be formed without crumbling when drier than plastic limit.

SOP-6805
STANDARD OPERATING PROCEDURE
DESCRIPTION OF SOILS

Figure 2. Example of an ERM Drilling Log

Environmental Resources Management						Point	
Location		Boring Depth (feet)				<div style="border: 1px solid black; width: 150px; height: 100px; margin: 0 auto; position: relative;"> N ↑ </div> <p style="margin-top: 5px;">Location Sketch Map</p>	
Date		Riser Length (feet)					
		Screen Length (feet)					
Screen	Sch. 40 PVC						
Slot Size	0.01 inches						
Riser	Sch. 40 PVC						

Depth (feet BGS)	Elevation (feet, MSL)	Well Construction Schematic	Color	Water	Material	Odor	Sample Description/Classification
	0						
2.5	-2.50						
10	-10.00						
12.5	-12.50						
15	-15.00						
17.5	-17.50						
20	-20.00						
22.5	-22.50						
25	-25.00						
27.5	-27.50						
30	-30.00						
32.5	-32.50						

<u>Construction Specifications</u>			
PVC Riser Interval (Feet BGS) Top Bottom	Portland Cement (Feet BGS) Top Bottom	Hydrated Bentonite Chip (Feet BGS) Top Bottom	
PVC Screen Interval (Feet BGS) Top Bottom	Sand Pack (Feet BGS) Top Bottom		

SOP-6806
STANDARD OPERATING PROCEDURE
MONITORING WELL AND PIEZOMETER INSTALLATION

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used when monitoring wells or piezometers are installed in consolidated and unconsolidated materials at a specific depth to collect representative ground water samples, determine ground water elevations, and provide observation points for aquifer testing. These monitoring wells or piezometers will be constructed of inert materials to eliminate the effect of construction material on ground water quality. Installation activities performed in Maryland should be completed in accordance with the applicable regulations set forth in Code of Maryland Regulations (COMAR) 26.04.04, as stated herein.

2.0 EQUIPMENT AND MATERIALS

- Pre-cleaned Schedule 40 PVC riser pipe and slotted well screen, flush-threaded joints, materials and diameter as specified in the Project Plan;
- Drilling rig with the appropriate capabilities;
- Bottom cap;
- Bentonite clay pellets or chips;
- Clean filter sand;
- Bentonite or cement-bentonite slurry;
- Locking water-tight cap;
- Above-ground protective casing;
- Flush-mount protective bolted manhole with rubber gasket;
- Concrete;
- Air-monitoring/PID meter;
- Air-monitoring/LEL meter;
- Pipe cutter; and
- Site-specific Health & Safety Plan (HASP).

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STANDARD OPERATING PROCEDURE
MONITORING WELL AND PIEZOMETER INSTALLATION

3.0

PROCEDURES

After the boring is complete to the target depth, the well or piezometer column will be assembled and installed. As an added protection, Teflon tape may be wrapped around the joint threads during assembly. No glue, solvent, or lubricating compound shall be used to make up the connection. The well or piezometer column will be constructed through the augers or drilling casing and carefully lowered to ensure it is properly centered. Once the well or piezometer column is in place, the top will be fitted with a locking water tight cap to prevent the introduction of foreign materials during later well construction procedures. All construction will conform to COMAR 26.04.04.07 Construction Standards whenever possible. All construction information will be recorded in the field notebook or log and submitted by the licensed Well Driller to the appropriate government agency (e.g., County or City Health Department). Attachment 1 provides an example of a well construction log.

Once the well column is placed, a filter sand pack will be carefully placed around the well screen for the purpose of reducing the introduction of fines during purging and sampling procedures. The sand will be poured through the augers or casings, which are periodically withdrawn to allow the sand to settle. The filter pack will extend approximately two feet above the top of the screen. Note that when installing bedrock wells, the top of the sand pack only extend to approximately one foot below the bedrock surface. The grain size chosen for the filter sand will be consistent with the slot size of the screen. The depth to the sand pack will be measured and recorded.

After the sand pack is firmly placed, a minimum of two feet of bentonite pellets or chips will be placed above the sand pack. This material will be added slowly to prevent bridging inside the augers. For bedrock monitoring wells and piezometers, the bentonite seal will be constructed in a manner to bridge the interface between the unconsolidated and consolidated materials. When the bentonite chips are installed in non-saturated conditions, approximately two to five gallons of potable water will be added to the pellets or chips for hydration in a ratio of not less than 2 pounds of bentonite per gallon of water. Bentonite will not be used if the water is below pH 5.0 or with total dissolved solids (TDS) content over 1,000 mg/L to conform to COMAR 26.04.04.07 G (4) (b). All construction data will be recorded.

A clean tremie pipe will then be placed inside the augers or casing for the placement of a thick, smooth bentonite or cement-bentonite slurry (cement-bentonite slurry will only be used with approval of the Project Manager). The slurry will be pumped under pressure until the augers or casings are full. The

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STANDARD OPERATING PROCEDURE
MONITORING WELL AND PIEZOMETER INSTALLATION

augers or casing will then be withdrawn and additional slurry will be added as needed. The slurry will fill the annular space between the well column and borehole to approximately three feet below ground surface. The slurry will be allowed to settle and stabilize for approximately 8 to 12 hours, at which time the hole is re-inspected for subsidence. If additional slurry is needed, it will be added. The amount of bentonite slurry, the mixture ratios of the slurry, the thickness of the slurry and any significant subsidence in the slurry level will be recorded.

For installation of shallow monitoring wells, bentonite chips may be used in lieu of slurry or grout if approved by the project manager. These bentonite chips will be periodically hydrated with potable water to promote formation of the impervious seal.

Prior to installing the protective casing, the well casing will be cut level with a pipe cutter or saw. The finished height of the well will depend on the type of protective device to be used (e.g., flush-mount or aboveground protective casing).

After the bentonite slurry has reached a static level, a protective casing or flush-mount manhole will be installed in concrete (if field construction conditions permit, the concrete will extend to a depth of approximately three feet). The concrete will extend approximately one foot from the edge of the casing. This concrete pad will be constructed so the surface slopes away from the casing enhancing surface water run-off from the wellhead. As an added precaution, the annular space between the well column and protective casing can be filled with a granular material and a small hole drilled near the base of protective pipe to discharge any water that may enter the protective casing.

If the well will be completed in a high traffic area, a flush-mount protective casing will be utilized. Like the aboveground protective casing, it will be installed in concrete (if field construction conditions permit, the concrete will extend to a depth of approximately three feet) and finished with a slope that drains surface water away from the well.

If required, the final step will be to paint the above ground protective casing using a highly visible and durable paint, in order to permanently attach a well designation marker.

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4.0 *DOCUMENTATION*

Permits to install each well will be obtained from the local health department in accordance with COMAR 26.04.04.03 and will be provided as part of the RI/FS final report. A well construction permit will be issued only to a person licensed by the Maryland State Board of Well Drillers as a master well driller, well driver, or well digger.

Well installation data will be recorded on the soil boring log or appropriate form. Installation details will include the total depth of the boring, the depth to the top and bottom of the well screen, the type of sand pack, the depth to top and bottom of the sand pack, the type of grout, the depth to top and bottom of the bentonite seal, the top and bottom of the bentonite slurry, the mixture ratios for the bentonite slurry, the depth to the bottom of the concrete, and any problems occurring during the installation of the well.

5.0 *SPECIAL NOTES*

Water will not be added to the borehole during drilling activities unless it is approved by the Project Manager. The attached figures show example of an ERM Drill Log and a monitoring well diagram.

To monitoring for fire and explosive hazard purposes a Lower Explosive Limit (LEL) meter and a (PID) will be used in conjunction to monitor the air in the vicinity of the operator's breathing space during drilling activities following the action level protocol established in the HASP (Section 8.0). Combustible gas readings will be taken prior to the commencement of any welding or when sparking electrical tools are to be used to minimize the possibility of explosion and/or fire.

6.0 *REFERENCES*

ASTM D-5092: Practice for Design and Installation of Ground Water Monitoring Well or Piezometers in Aquifers.

COMAR Title 26, Subtitle 04, Chapter 04 - Well Construction.

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Environmental Resources Management
Boring / Well Construction Log



Boring/Well ID: _____

Site Name & Location:					Date & Time Started:		
Project Number:					Date & Time Completed:		
Drilling Company:					Drilling Equipment:		
Driller:					Drilling Method:		
Reference Elevation & Datum:					North Coordinate:		
Ground Elevation & Datum:					East Coordinate:		
Borehole Diameter:					Well Diameter & Material:		
Borehole Depth:					Screen Slot Size:		
Sampler Type & Interval:					Geologist (s):		

Depth (feet BGS)	Sample Interval (ft)	Well Construction Schematic	Blows per 6 inches	Recovery (feet)	pH (ppm)	pH Head-space (ppm)	Sample Description/Classification
2							
4							
6							
8							
10							
12							
14							
16							
18							
20							
22							
24							
26							
28							

Monitoring Well Construction Specifications:

Paver Interval (feet BGS): _____

Screen Interval (feet BGS): _____

Portland Type 1 Concrete (feet BGS): _____

Bentonite Chips (feet BGS): _____

#1 Mone Sand Filter Pack (feet BGS): _____

Figure 1. Example of an ERM Drilling Log

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STANDARD OPERATING PROCEDURE
MONITORING WELL AND PIEZOMETER INSTALLATION

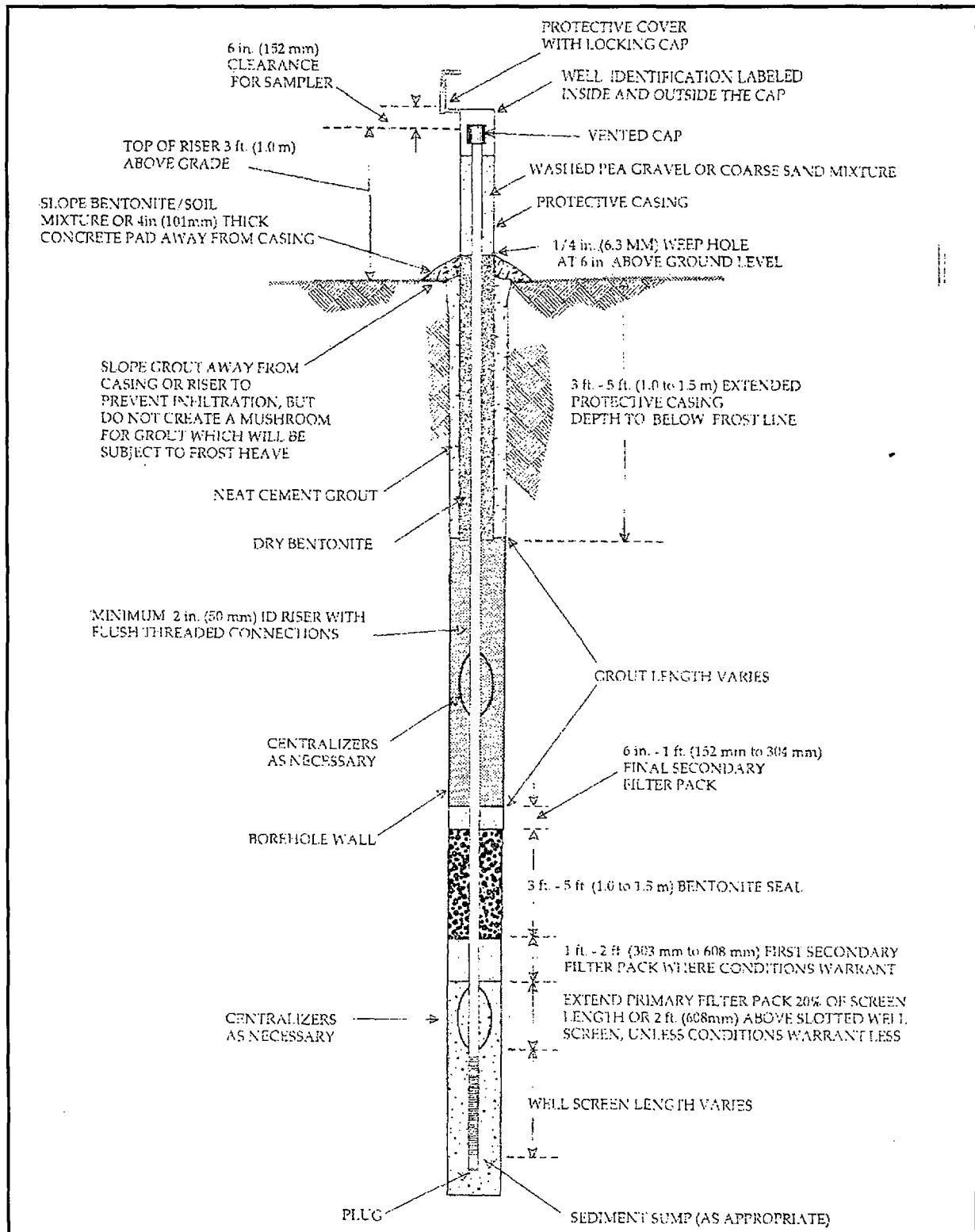


Figure 2. Diagram of a Monitoring Well

SOP-6807
STANDARD OPERATING PROCEDURE
MONITORING WELL/PIEZOMETER DEVELOPMENT

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that will be followed during the development of monitoring wells/piezometers. The purpose of monitoring well development is to remove fines from the vicinity of the well screen to allow free flow of formation water through the well screen. Development also reduces turbidity during sampling events. The most common well development methods are surging, jetting, over-pumping, and bailing. Development should not be conducted immediately after well installation so that grouting and seal materials can adequately set. A period of 48 hours is typically adequate time for neat cement or bentonite grout mixtures to cure.

Although this procedure is typically implemented shortly after well installation, it may be necessary to redevelop a monitoring well if fines accumulate in the well. Redevelopment may be warranted if, over time, there is a drop in water yield during purging, an increase in turbidity, or sediment accumulation in the bottom of the well.

2.0 EQUIPMENT AND MATERIALS

- Portable photoionization detector (PID) or flame ionization detector (FID) only if necessary;
- Multi-gas meter (for percent LEL);
- Interface probe or water level indicator;
- Submersible pump (optional);
- pH, temperature, conductivity meters and appropriate calibration solutions;
- Turbidity meter (optional);
- Calculator;
- Inertial lift pump foot valves and tubing (e.g., Waterra™);
- Surge blocks;
- Dedicated or reusable bailer constructed of Teflon, stainless steel, disposable weighted polyethylene, or other acceptable material;
- Polypropylene rope or other suitable bailer cord;

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MONITORING WELL/PIEZOMETER DEVELOPMENT

- Five gallon buckets;
- 55-gallon drums or other appropriate storage container for purge water;
- Latex sample gloves;
- Decontamination supplies as described in SOP No. 6819; and
- Site-specific Health & Safety Plan (HASP).

3.0 PROCEDURES

3.1 FIELD PREPARATION

1. All pertinent well construction details including drilling method, well depth, well diameter, borehole diameter, screened interval, and filter length will be obtained from the well construction log for each well to be developed and recorded on the appropriate field data sheet and/or field notebook.
2. Test, calibrate, and charge all instrumentation **before leaving for the field.**
3. The appropriate well development technique shall be at the discretion of the project manager. Necessary equipment and supplies will vary depending on which technique is employed. It is important to determine the appropriate storage and disposal options for decontamination and development fluids before commencing with field activities.

3.2 WELL DEVELOPMENT FIELD PROCEDURE

1. A visual inspection of the wellhead condition will be documented in a field notebook before opening the well.
2. The HASP may require PID, LEL, and/or O₂ readings of the ambient air before opening the wellhead. The PID and LEL meters will be calibrated in the field according to manufacturer's specifications and recorded in the field notebook. The HASP will dictate how to proceed based on the air screening results.

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MONITORING WELL/PIEZOMETER DEVELOPMENT

3. After the environment in the vicinity of the wellhead is deemed satisfactory, the well will be opened and the air conditions in the well column determined as specified in the HASP. The protective casing of the well/piezometer will be unlocked and the cap will be removed. The HASP may require PID, LEL, and/or O₂ readings of the air quality in the riser before proceeding. The HASP will dictate how to proceed based on the air screening results.
4. The monitoring well will be allowed to stabilize for at least 10 minutes after removing the well cap.
5. The water level will be measured using a water level meter or, if warranted, an interface probe. The interface probe or water level indicator will be decontaminated in accordance with SOP No. 6819 prior to collecting water level measurements.
1. The probe will be slowly and carefully lowered into the well column until the water level is encountered. The water level indicator will emit an audible signal when it makes contact with water. Measurements will be taken from the survey mark indicated on the top of the well casing. If a mark is not already indicated, the uppermost portion of the inner casing should be used as the measurement point. This point should then be marked for future reference. Record the depth to water in the field notebook. Proceed by slowly lowering the tape until the probe touches the bottom of the well. Record the depth to bottom in the field notebook. After the water level measurement procedure is complete, the probe and all measuring tape lowered into the well will be thoroughly decontaminated in accordance with SOP No. 6819.
6. Purge and well volumes will be calculated in the field based on a conversion factor that represents the gallons of water in the well per foot of standing water. The following equation is used to calculate the volume of water in a well:

$$\text{Well Volume (V)} = \pi r^2 h (\text{cf})$$

(1)

where:

$$\pi = \text{pi (3.141592)}$$

$$r = \text{radius of monitoring well in feet (ft)}$$

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h = height of water column in ft

cf = conversion factor in gallons per cubic foot (gal/ft^3) = 7.48 gal/ft^3 .

The well diameter (in inches) must be converted to the radius in feet as follows:

$$\left(\frac{\text{diameter}}{12}\right) * 0.5 = r \text{ (ft)}$$

(2)

The volume, in gallons per linear foot, for various standard monitoring well diameters may be calculated as follows:

$$V \text{ (gal/ft)} = \pi r^2 (cf)$$

(3)

Table 1. Volume in gallons/feet for typical monitoring well diameters.

Well Diameter (inches)	1.0	2.0	4.0	5.0	6.0	8.0
Volume (gal/ft)	0.04	0.16	0.65	1.0	1.5	2.6

Using Table 1, field personnel may calculate well volumes knowing only the gal/ft of water per well diameter and the height of the water column using the following equation, which is modified from Equation 1:

$$\text{Well Volume (V)} = (h)(f)$$

(4)

where:

f = the volume in gal/ft as shown in Table 1.

7. The well may be developed using one of the following methods at the project manager's discretion.
 - A. Surging involves raising and lowering a surge block or surge plunger at a constant rate along the screened interval to allow water to flow through the column of tubing. This method is very effective for two-inch and four-inch monitoring wells. The surging motion forces water into the formation and loosens sediment to be pulled from the

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MONITORING WELL/PIEZOMETER DEVELOPMENT

formation into the well. A foot valve is attached to the end of semi-rigid tubing and lowered into the well. The readings and notes on groundwater turbidity will be recorded in the field notebook or on the appropriate field data sheet. Low yielding wells from which at least ten well volumes cannot be removed will be completely evacuated. Once the well is evacuated, a suitable waiting period shall be determined and the well will be allowed to recharge. The well shall be evacuated as many times as is practical. Once the correct amount of water is purged, the valve shall be removed and the tubing discarded. A new piece of tubing will be used in each subsequent well. The valve will be decontaminated according to SOP No. 6819. Note: A two-inch diameter well can be developed manually using the surge block method. An alternate power source (e.g., a drilling rig should be used to surge wells with a diameter greater than two inches.

- B. Jetting and vacuuming involves lowering a small diameter pipe into a well a few feet above the well screen and jetting air or water into the well so that the fines are geysered out the top of the well and evacuated with a vac truck. This process will continue until the groundwater is sediment free. It is important not to force water or air across the screened interval. Doing so may cause fines in the well to clog the screen openings and/or cause hydro-fracturing near the well screen. This method is more suitable for wells completed in fractured rock.
- C. Over-pumping involves pumping water from the well using a *Grundfos* or *Whale* pump, for example. Over-pumping is often conducted in conjunction with surging using a surge block or surge plunger to agitate the fines. Alternatively, the pump may be raised and lowered in the well screen interval to effectively surge the well. Water will be pumped at a rapid enough rate to draw the water down as low as possible, and allowing it to recharge. This procedure will be repeated until the groundwater is sediment free. The pump will be decontaminated in accordance with SOP No. 6819 between wells and documented in the field notebook.
- D. Bailing involves using PVC, stainless steel, Teflon, or other acceptable materials. The bailer will be raised and lowered in the water column to agitate the fines and to move water through the well filter pack. The well will be bailed from the bottom of the water column to remove settled fines. It is important to avoid letting the bailer free fall to the bottom of the well as such an action could cause the bottom of

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MONITORING WELL/PIEZOMETER DEVELOPMENT

the well casing to break. When the bailer is full, it will be retrieved and the contents carefully transferred into a five-gallon bucket. This procedure will be repeated until the groundwater is relatively sediment-free. When using this development technique, a new rope will be attached to the bailer for each well, and the bailer will be decontaminated between wells in accordance with SOP No. 6819. Decontamination procedures will be recorded in the field notebook.

8. The duration for well development varies based on the well development method used. Generally, development should proceed over three successive well volumes, or until the water appears clear and the pH, temperature, and conductivity have stabilized. Parameters should be measured at the start of purging and after each well volume.

In some instances the collection of non-turbid samples is difficult or unattainable. In the case that a well does not provide sediment-free samples, development may cease if:

- A. A minimum of five well volumes has been removed, plus any water added during well construction and development;
 - B. pH, temperature, and conductivity measurements have stabilized;
 - C. Several procedures have been tried, or historical site data establishes a precedent for the most practical method or duration; or
 - D. Proper well construction has been verified.
9. The Project Manager shall determine the appropriate method for storing and disposing of decontamination and development water. In most cases, decontamination and development water will be stored in properly labeled 55-gallon drums and staged in a safe location.

4.0

DOCUMENTATION

The following data will be recorded in the field notebook for each well in addition to what is outlined above:

1. Well ID;
2. Date of well installation;

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3. Date and time of well development;
4. Static water level and depth to bottom before and after development;
5. Quantity of water removed and time of removal;
6. Field parameters during development;
7. Type and size/capacity of pump and/or bailer used; and
8. Description of well development technique(s) used.
9. Waste management documentation for decontamination and well development water (drum inventory or label documentation)

Any deviation from the above-described procedures will be performed only with prior approval of the Project Manager.

5.0 SPECIAL NOTES

Extraction wells are typically better developed using equipment and methods provided by the drilling contractor. These wells typically have diameters greater than four inches and require larger equipment to achieve proper development. This equipment includes, but is not limited to, large diameter surge blocks, large diameter bailers, water jetting systems, and high capacity submersible pumps. Consult with the Project Manager regarding extraction well development.

6.0 REFERENCES

US EPA, 2001. Monitor Well Development, SOP#: 2044, DATE: 10/23/01, REV. #: 0.1, U.S. EPA Environmental Response Team, Standard Operating Procedures, <http://www.ertresponse.com/index.htm>.

SOP No. 6819: Decontamination of Sampling Equipment.

SOP-6808
STANDARD OPERATING PROCEDURE
INVESTIGATION-DERIVED MEDIA

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used to properly contain or store drilling fluids that will be re-circulated from a borehole, extracted from a monitoring well, or generated during decontamination activities. Also, this section documents the procedures to be followed to properly contain auger cuttings, unused soil samples or soils excavated in areas of known or suspected contamination.

2.0 EQUIPMENT AND MATERIALS

- Five-gallon buckets;
- Activated carbon;
- Thirty-gallon trash can;
- Portable water tank (of appropriate size);
- DOT-approved, closed-top, 55-gallon steel drum;
- Paint pen or permanent marker (indelible);
- Shovel;
- Plastic sheeting;
- Straw bales;
- Stakes or concrete blocks; and
- Site-specific Health & Safety Plan (HASP).

3.0 GENERAL

Investigation-derived Media (IDM) should be managed, contained, sampled, or replaced within a reasonable time frame from the generation of such media.

3.1 MANAGEMENT OF PURGE WATER AND DECONTAMINATION FLUIDS

Small quantities of groundwater (20 gallons or less per well) extracted from wells that are not designated for laboratory analysis and decontamination fluids for field equipment (e.g., sampling spoons, water level probes, etc.) will be

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INVESTIGATION-DERIVED MEDIA

contained, treated, and discharged to the ground surface. The water will be initially contained in a DOT-approved 55-gallon drum, or other acceptable container. The fluids will then be conveyed through a filter bed of activated carbon for treatment. Any visible liquid product or sheen will be removed, via skimmers or absorbent materials, prior to carbon treatment. Upon treatment, the water will be discharged to the ground surface. All decontamination fluids from field vehicles (e.g., drilling rigs, support trucks, backhoes, etc.), visible liquid product, or waters with a sheen will be contained in a DOT-approved 55-gallon drum, or other acceptable container and disposed at a USEPA-approved off-site disposal facility in accordance with appropriate federal, state and local regulations for transport and disposal. The specific procedures are presented in Section 4.0.

3.2

MANAGEMENT OF DRILL CUTTINGS AND EXCAVATED MEDIA

Drill cuttings and excavated solid media produced from drilling operations, test pit excavation, augering, and other intrusive activities that are not saved for physical or chemical analyses will be placed back into the borehole or test pit/trench excavation from which they originated. Solid media will be placed into the original borehole or excavation in accordance with the procedures described in Section 4.0. Any remaining solid media that cannot be placed into the borehole or excavation will be managed in the following manner:

1. Unimpacted solid media that does not exhibit waste-like characteristics will be spread on the ground surface in the immediate vicinity of its origin, covered with a minimum of one foot of cover soil, and seeded;
2. Solid media that exhibits waste-like characteristics (i.e., elevated reading on an organic vapor analyzer (OVA) or other field monitoring device, unnatural staining or discoloration, odors, etc.) will be containerized on-Site in DOT-approved 55-gallon drums, or other acceptable containers, for consideration in the final remedy. The auger cuttings or excavated materials that remain from various locations may be mixed; or,
3. Solid media that exhibits waste-like characteristics (e.g., NAPL) and is determined to be hazardous through laboratory analysis will be containerized in DOT-approved 55-gallon drums, or other acceptable containers, for final disposal at an approved waste disposal facility.

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STANDARD OPERATING PROCEDURE
INVESTIGATION-DERIVED MEDIA

4.0 PROCEDURES

4.1 CONTAINERIZATION

Drums used to containerize auger cuttings, excavated solid media, drilling fluids, purge water, decontamination water, etc. will be clean, DOT-approved, 55-gallon drums with bolt-secure open-top lids, or other acceptable containers. Each container shall be clearly labeled with the following information:

- Generator Name and Address;
- Site Name and Location;
- Date;
- Soil Boring Number(s); and,
- Contents.

If multiple drums are needed for a particular location, they will be consecutively numbered as they are generated. Any containers that are used for temporary storage to containerize media overnight should be clearly marked as "Temporary" and include the above information.

4.2 GROUNDWATER AND DECONTAMINATION WATER

Groundwater and decontamination water will be temporarily contained in an acceptable container. Field personnel will observe the waters for any visible non-aqueous phase liquid (NAPL) or sheen. If observed, the NAPL or sheen will be removed via a skimmer or absorbent pads. NAPL or sheen that is removed by a skimmer or absorbent pads will be placed in a DOT-approved 55-gallon drum for future disposal.

Groundwater and decontamination water that do not contain NAPL or a sheen will be treated, via activated carbon filter bed and discharged to the ground surface. The quantity of water will determine the design of the filter bed. Small quantities of groundwater (20 gallons or less) are anticipated during purging, sampling, other extraction activities, and decontamination of sampling/monitoring equipment. A 5-gallon bucket of activated carbon will be sufficient. The design and construction of the carbon system is presented in the attached Figure 1. A greater quantity of water is likely to be generated from the decontamination of drilling equipment and support vehicles. Quantities of water greater than 20 gallons per location will be containerized in DOT-approved 55-

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INVESTIGATION-DERIVED MEDIA

gallon drum for future disposal. Alternatively, larger containers of activated carbon may be used, accordingly, to treat larger quantities of waters (e.g., 55-gallon drums, 2,000-lb vessels) prior to discharge. It may be necessary to obtain a National Pollutant Discharge Elimination System (NPDES) permit for the discharge of larger quantities of treated water. The spent carbon will be disposed at an USEPA-approved disposal facility.

4.3 DRILL CUTTINGS AND EXCAVATED SOLID MEDIA

Drill cuttings will be replaced into the boring to the extent practical. The fill should be tamped with a rod to maximize compaction and densification of the backfilled soil. The top one foot of the borehole should be filled with the original, surficial one-foot of material, or alternatively post-hydrated bentonite.

Excavated solid media will be placed into the excavation from which it was removed. During excavation, the upper one-foot of material will be initially removed and stored separate from the remainder of the material. During filling, the media removed from below one foot will be initially placed into the excavation. The material will be tamped to compact the fill to the extent possible. The upper one-foot of material will then be placed over the previously placed fill and tamped. The area will be uniformly graded to match its original condition to the extent practical. Seed will be placed over the backfilled excavation.

Solid media that cannot be replaced into the original borehole or excavation will be managed in accordance with Section 3.2. Any media spread within the vicinity of the hole or excavation will be graded uniformly and covered with one foot of clean, off-site cover soil. Both the excavated media and the cover soil will be compacted, to the extent practical; i.e., tamping or tracking over the material with the equipment. The filled area will be seeded and stabilized to limit erosion.

5.0 DOCUMENTATION

5.1 DRILLING FLUIDS, PURGE AND DECONTAMINATION WATER

The following information will be recorded in the field notebook:

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INVESTIGATION-DERIVED MEDIA

- The volume of water extracted from a soil boring or well from installing, sampling, testing etc, as well as the dates generated and the source (i.e., location) will be recorded;
- The location of any staged drums, tanks, boxes, etc will be recorded;
- If photographs are taken, a log should be noted;
- If samples are analyzed, they should be recorded;
- The volume of decontamination fluids shall be recorded;
- The treatment container volume will be recorded; and,
- Carbon replacement will be recorded.

5.2. FOR DRILL CUTTINGS AND EXCAVATED MATERIAL

The following information will be recorded:

- If auger cuttings are placed in drums, the following information will be included on the soil boring log, field notebook, or in the daily field report:
 - The number of drums generated;
 - Labeling procedures; and
 - The type of drums used.
- If auger cuttings or excavated soils are temporarily stockpiled and replaced into the borehole or excavation, this will be noted on the soil boring log, field notebook, or the daily field report. The estimated volume of soil produced from each source will also be noted.
- For locations that the media are spread and covered, the approximate dimensions of the area, thickness of the media, source and type of cover soil, and methods of material and fill placement will be recorded. Silt fence will be placed around all material from borings and excavations that is spread on the ground surface as well as all test-pit locations. These locations will be seeded and hydrated as appropriate to ensure proper erosion control.
- Photographs should be taken of the drum staging area or the excavation to document that proper handling procedures were followed.

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INVESTIGATION-DERIVED MEDIA

5.3 WASTE PROFILE SHEETS AND WASTE MANIFESTS

The Coalition will be fully responsible for documents regarding the disposal of any waste, debris or other material generated by or otherwise resulting from the investigation activities. Copies of the waste profile sheets and waste manifests will be maintained with the project files. Copies of the transporter's permits for State of origin and State of destination should also be maintained with the project files.

5.4 IMPORTED SOIL MATERIAL

Documentation that the imported soil cover material is clean and does not pose an unacceptable risk under current land use conditions will be maintained with the project file.

6.0 SPECIAL NOTES

ERM will act on behalf of the Coalition as the designated agent with authority to sign waste manifests.

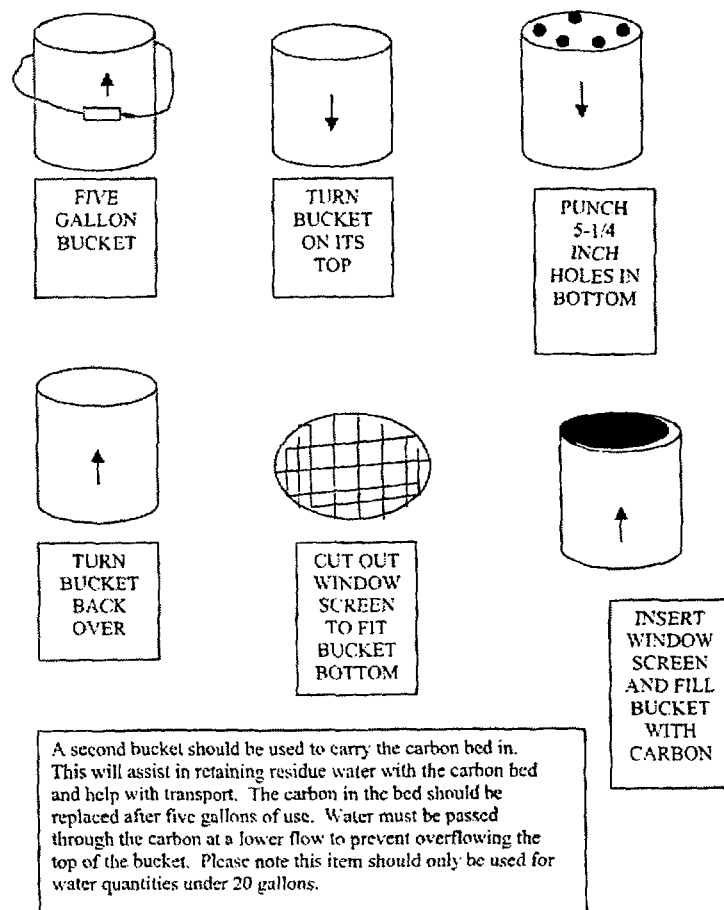
7.0 REFERENCES

Maryland Department of the Environment (MDE), 2003. *Maryland Environmental Assessment Technology for Leaking Underground Storage Tanks, Appendix E: Investigation Derived Wastes, Treatment, and Disposal*. February 2003.

United States Environmental Protection Agency (USEPA), 1992. *Guide to Management of Investigation-Derived Wastes*. 9345.3-03FS. January 1992.

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INVESTIGATION-DERIVED MEDIA

Figure 1. Carbon Filtration Unit for Treating Small Quantities of Water

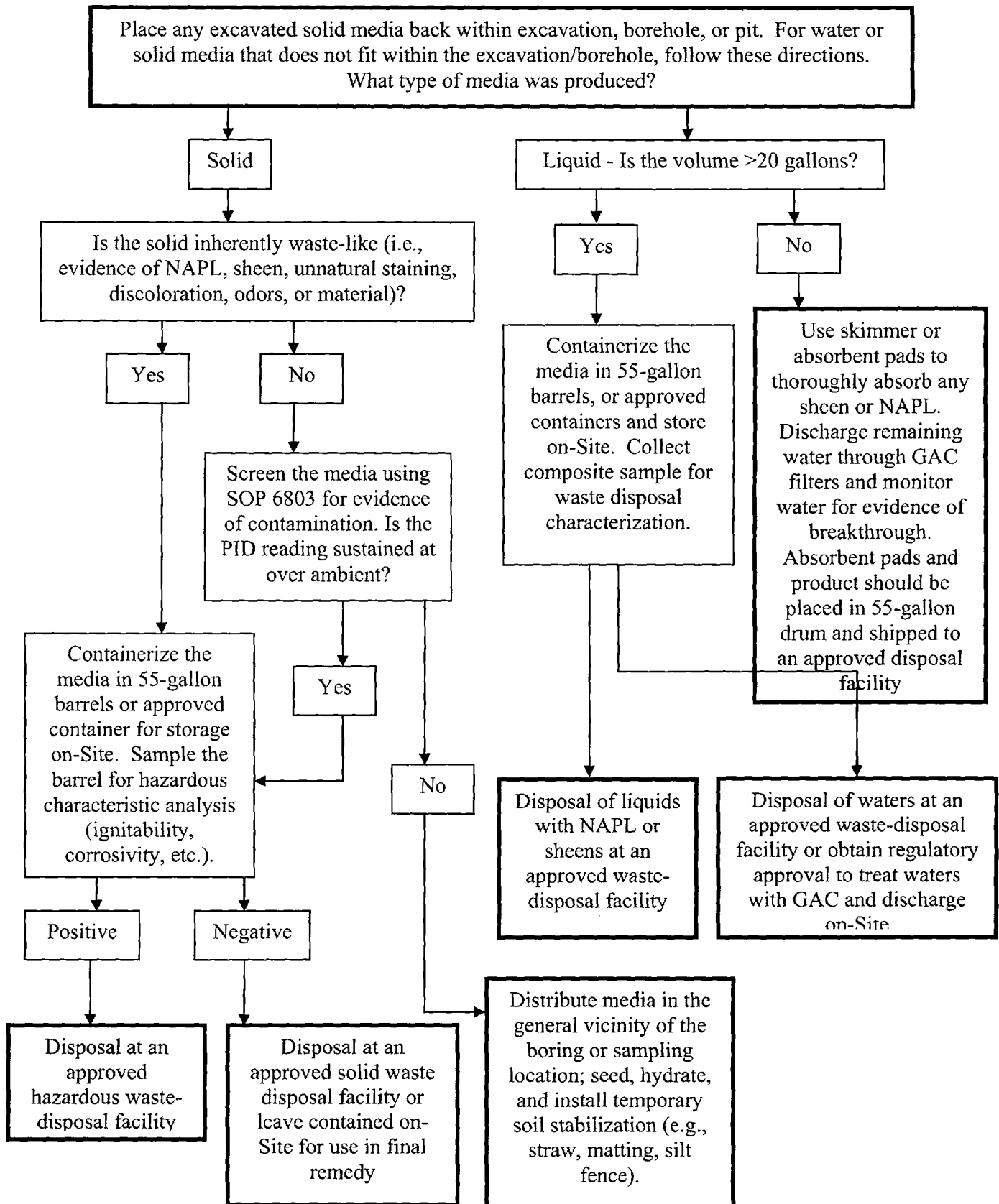


02.2003

36

Source: MDE, 2003.

Attachment 1
Decision Process for Management of Investigation Derived Media



GAC – Granular Activated Carbon

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STANDARD OPERATING PROCEDURE
GEOTECHNICAL SOIL SAMPLING

1.0 PURPOSE

This section documents the procedures for collecting soil samples for geotechnical testing. The procedure describes geotechnical soil sampling from soil borings and test pits, including disturbed and undisturbed samples. Geotechnical sampling procedures are different from those specified for analytical testing purposes.

2.0 EQUIPMENT AND MATERIALS

- Soil borings will be installed using hollow-stem drilling methodology and equipment as described in SOP No. 6800. A shallow soil sample may also be obtained from hand auger borings.
- Test pits will be excavated with conventional construction equipment, such as a backhoe or excavator.
- Hand shovel.
- Sampling gloves.
- Sample containers.
- Decontamination equipment, if necessary.

3.0 PROCEDURES

The sampling procedure varies depending upon whether a disturbed or undisturbed sample is required. Additionally, sample collection from a soil boring or test pit will further determine the sampling technique.

3.1 DISTURBED SAMPLES

Disturbed samples can be obtained from various sources, including hollow-stem auger soil borings, hand auger borings, and test pits.

3.1.1 Hollow Stem Auger Soil Borings

- Soil samples will be collected by drilling to the top of the desired sampling interval with a split spoon sampler advancing through the lead auger into undisturbed soil/overburden material. Split spoon samples

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STANDARD OPERATING PROCEDURE
GEOTECHNICAL SOIL SAMPLING

will be collected in accordance with ASTM D1586, "Standard Method for Penetration Test and Split-Barrel Sampling of Soils" ..

- Alternatively, five-foot continuous samplers can be advanced as the augers are advanced. The sampler will be retrieved following each five-foot auger run.
- A third alternative can be used only with the project manager's approval. A sample of soil can be collected from the soil cuttings that travel up the auger flight to the collar of the hole. Soil mixing throughout the vertical profile may occur and thus should be considered.
- Standard Penetration Test (SPT) blow counts will be recorded for each boring.
- Samples should be inspected, logged, and recorded (see Section 4.0 - Documentation).

3.1.2 *Hand Auger Soil Borings*

- As the hand auger advances, soil will be placed in separate piles in an orderly manner according to depth.
- Soils from consecutive piles with a similar soil type will be combined to form a single sample. Equal parts from each of the appropriate piles will be used to comprise the sample.
- Samples should be inspected, logged, and recorded (see Section 4.0 - Documentation).

3.1.3 *Test Pits*

- An area from the sidewall should be selected for obtaining a sample. Where possible, the surface of the designated area should be scraped to remove weathered and mixed materials.
- Further inspection should be performed to determine soil consistency and areas of change in gradation, color, water content, and other geotechnical properties.
- Depending on the depth of the trench, the sample can be obtained by hand or traditional construction equipment. A uniform cut should be made down the vertical face of the trench wall. If the cut is made by hand, several cuts should be performed and the soils from each cut placed in piles on a tarp or plastic sheet. After visual inspection, an individual sample or composite from each of the piles is collected. If the cut is made by construction equipment, the soils will be placed on a tarp

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STANDARD OPERATING PROCEDURE
GEOTECHNICAL SOIL SAMPLING

or plastic sheet. After visual inspection, soils from different areas of the pile are mixed to form a representative composite sample.

- Samples should be inspected, logged, and recorded (see Section 4.0 – Documentation).

3.1.4 *Protection and Preservation of Samples for Shipment*

- The quantity of sample will determine the suitable container for sample storage. Refer to Section 3.3 – Sample Quantity.
- All samples should be placed in bags, sealable buckets, or other acceptable sealable containers to prevent the loss of moisture.
- For small-quantity samples, the representative sample should be placed in a one-gallon Ziplok bag, or equivalent. The bag should be zipped and tapped at the top to ensure that it will not accidentally re-open. The bags should be placed in a durable container for shipping, such as a plastic bucket.
- For large-quantity samples, the representative sample should be placed in a 5-gallon, plastic bucket with a snap-close lid for a tight seal. The lid should also be taped to the bucket to ensure that it will not accidentally re-open.
- The containers should be labeled with permanent marker and accompanied by a Chain of Custody.

3.2 **UNDISTURBED SAMPLES**

Undisturbed soil samples can be obtained from various sources, including hollow-stem auger soil borings, hand auger borings, and test pits. Various geotechnical sampling procedures are available; however, Shelby tubes are appropriate for most conditions anticipated on-Site and thereby discussed herein. If it is determined that the conditions are not suitable for Shelby tube sampling; i.e., noncohesive sands, other methods may be considered.

3.2.1 *Hollow Stem Auger Soil Borings*

Soil samples will be collected by first drilling to the top of the desired sampling interval. A standard 36-inch long Shelby tube will be lowered into the hole to collect the sample. The tube should not rotate and should be pushed into the soil at a controlled penetration rate and pressure.

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STANDARD OPERATING PROCEDURE
GEOTECHNICAL SOIL SAMPLING

3.2.2 *Hand Auger Soil Borings and Test Pits*

Soil samples will be collected by first augering or excavating to the top of the desired sampling interval. To the extent possible, the loose soil should be removed from the top of the sample area. A standard 36-inch long or 12-inch long Shelby tube (dependent on the required sample quantity) will be placed onto the prepared surface. A chain or cable should be placed through the holes in the tube to facilitate extraction. The tube is then pushed, via a backhoe bucket or other equipment, into the soil at a controlled penetration rate and pressure. The tube should not rotate and should be pushed at a constant pressure. Upon reaching the desired depth, the tube is lifted from the soil at a constant rate.

3.2.3 *Protection and Preservation of Samples for Shipment*

- Refer to the attached JLT Laboratories, Inc. "Shelby Tube Packing" instructions.
- The containers should be labeled with permanent marker and accompanied by a Chain of Custody.

3.3 *SAMPLE QUANTITY*

Guidance for the quantity of sample required for each geotechnical test is presented below. The specific quantity may vary depending on the testing laboratory; therefore, the quantity should be confirmed with the particular laboratory prior to sampling activities.

Test	Test Method	Quantity Required
Gradation w/ hydrometer	ASTM D-422	4 to 5 lbs
Soil Classification	ASTM D-2487	
Atterberg Limits	ASTM D-4318	
Moisture Content	ASTM D-2216	
Bulk Density	ASTM D-4531	
Consolidation	ASTM D-2435	One 36-inch Shelby tube
Triaxial Shear Strength (3 point)	ASTM D-4767	

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STANDARD OPERATING PROCEDURE
GEOTECHNICAL SOIL SAMPLING

4.0 DOCUMENTATION

Each soil sample should be inspected, described, and logged into the field book in accordance with the Soils Description and Field Classification SOP No. 6812. The plan location, depth of sample, and other pertinent information should also be recorded. A copy of any applicable shipping papers shall be retained for future reference. Any pertinent shipping information should be recorded on the Daily Field Report or in the field notebook for the project.

5.0 SPECIAL NOTES

Reference other SOPs for boring abandonment, decontamination, chain-of-custody, and other related information.

6.0 REFERENCES

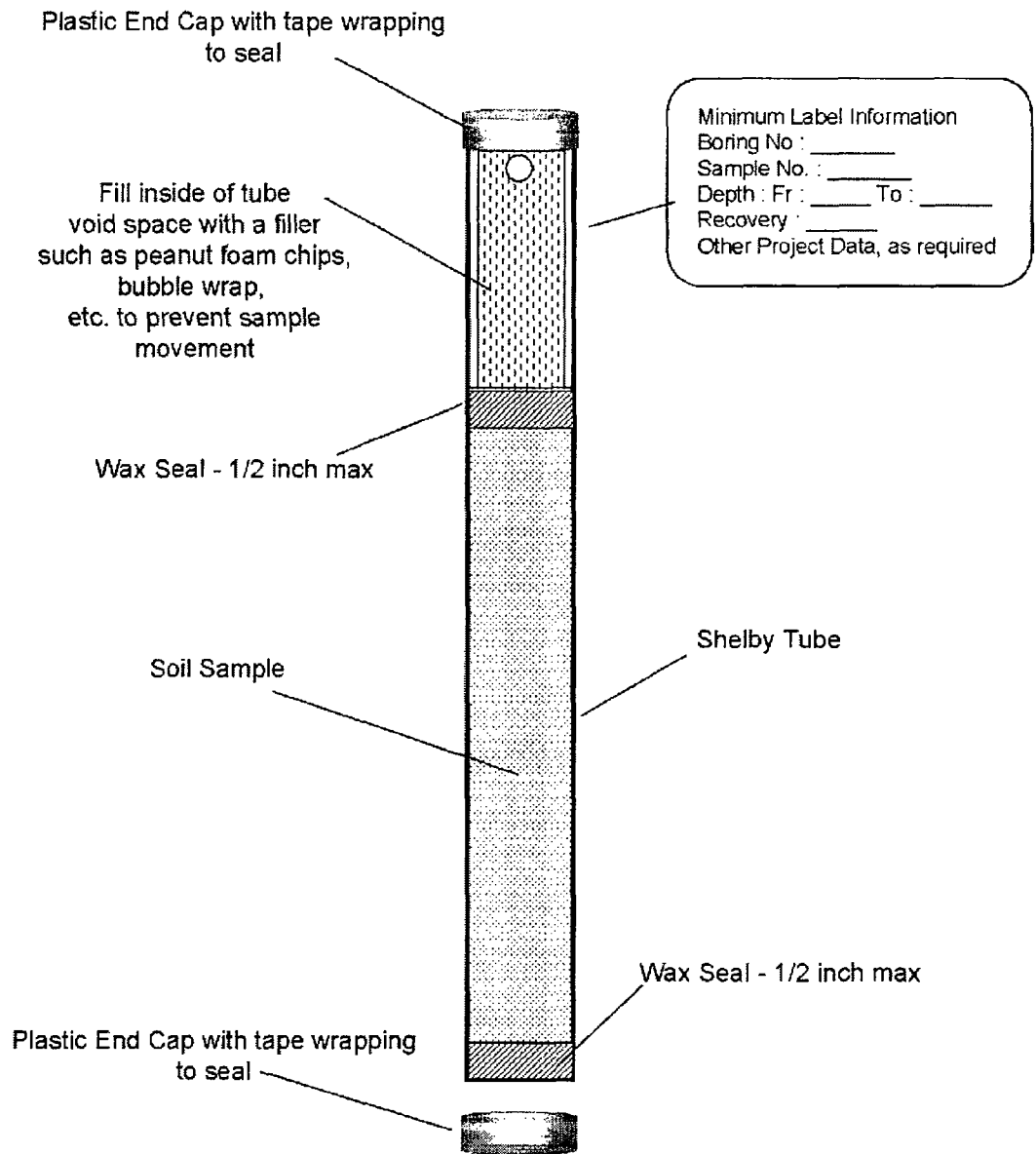
ASTM D 1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

United States Department of the Interior - Bureau of Reclamation. *Design of Small Dams*. Third Edition. 1987.

Winterkorn, Hans F. and Fang, Hsai-Yang. *Foundation Engineering Book*. Van Nostrand Reinhold Company, 1975.

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STANDARD OPERATING PROCEDURE
GEOTECHNICAL SOIL SAMPLING

SHELBY TUBE PACKING



Note: ASTM suggests using Bees Wax which is quite expensive. An alternate is parafin canning wax you can purchase at any grocery store. Melt one box of wax (which is about the size of a pound of butter) and mix it with 1/3 can of cheap motor oil.

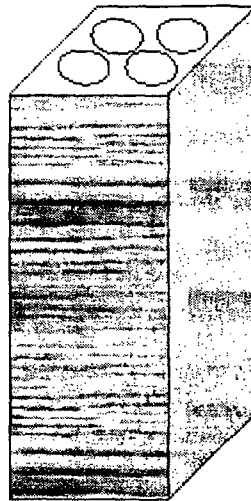
This will turn the wax from a white to a golden color and will make it pliable.

DO NOT USE WHITE PARAFIN CANNING WAX WITHOUT THE OIL
IT LOCKS AGAINST THE TUBE PREVENTING HYDRAULIC EXTRACTIONS

JLT Laboratories, Inc.

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STANDARD OPERATING PROCEDURE
GEOTECHNICAL SOIL SAMPLING

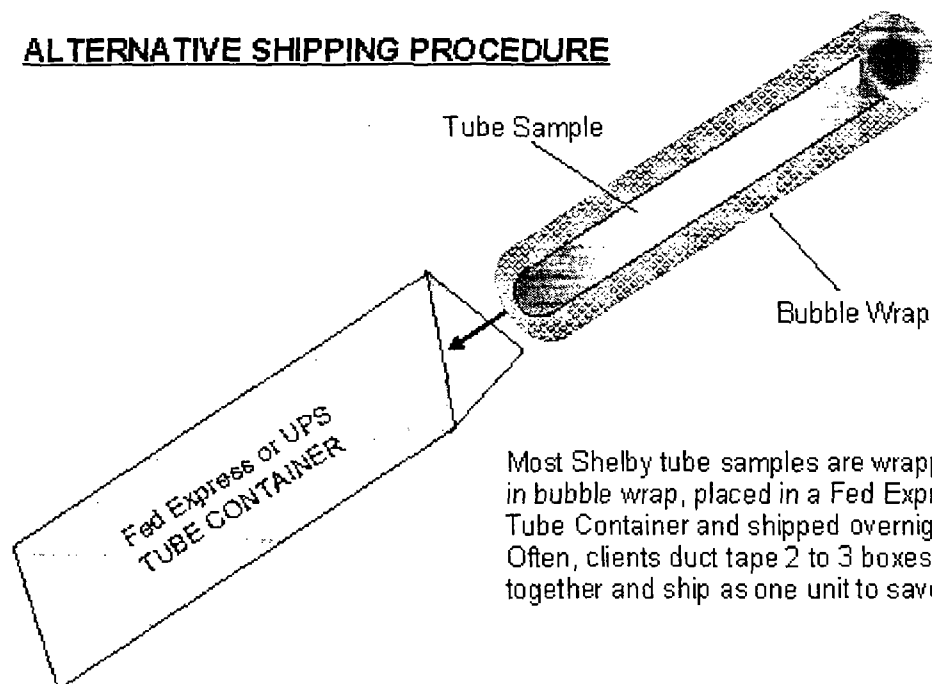
ASTM SHIPPING PROCEDURE FOR 30 AND 36 INCH TUBES



ASTM suggests that the tubes be placed in a wooden box with a couple of spacers to hold the tubes in place. The box top is screwed on for easy removal. This is a costly method of shipment and only used by a couple of our clients who do mostly government/ Corps of Engineers work.

See ASTM D-4220, "Preserving and Transporting Soil Samples", Figure 2.

ALTERNATIVE SHIPPING PROCEDURE

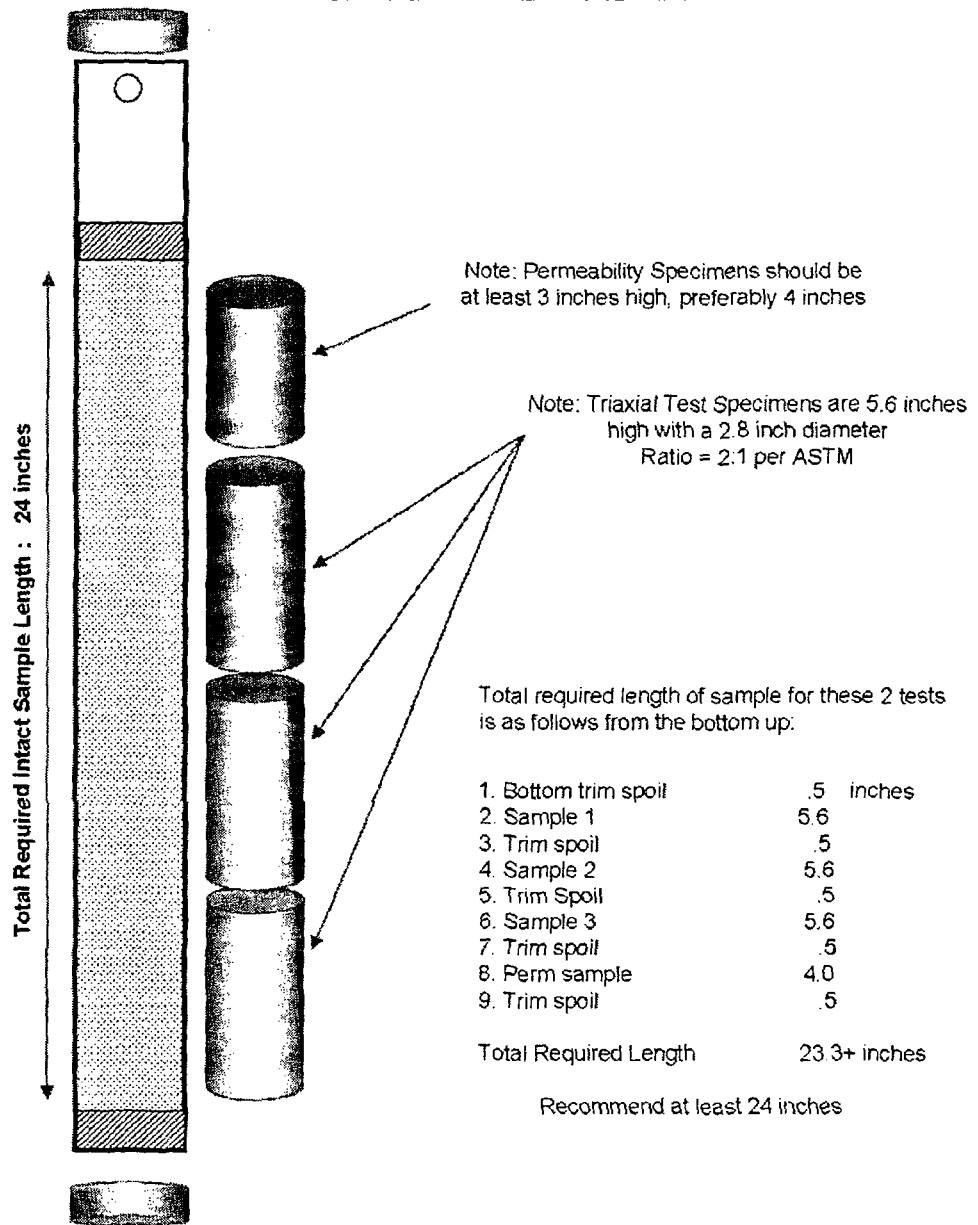


Most Shelby tube samples are wrapped in bubble wrap, placed in a Fed Express/UPS Tube Container and shipped overnight. Often, clients duct tape 2 to 3 boxes together and ship as one unit to save costs.

JLT Laboratories, Inc.

SOP-6809
STANDARD OPERATING PROCEDURE
GEOTECHNICAL SOIL SAMPLING

**SAMPLE LENGTH REQUIREMENTS
FOR
STRENGTH AND PERMEABILITY TESTING**



SOP-6811
STANDARD OPERATING PROCEDURE
MEASURING STREAM DISCHARGE

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used to measure stream discharge.

These are SOPs which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

2.0 EQUIPMENT AND MATERIALS

Equipment needed for collection of surface water samples may include (depending on technique chosen):

- Field data sheets;
- Measuring tape;
- Hand-held flow meter;
- Maps/plot plan;
- Waders;
- Safety equipment (including personal flotation devices, and safety ropes, etc.);
- Survey stakes, flags, or buoys and anchors;
- Digital camera;
- Logbook/waterproof pen; and
- Site-specific Health & Safety Plan (HASP).

3.0 PROCEDURES

Discharge measurements will be made at each of the designated monitoring locations along the primary drainages.

The first step in streamflow measurement is selecting a cross section across the total width of the stream. Select a straight reach where the streambed is uniform

SOP-6811
STANDARD OPERATING PROCEDURE
MEASURING STREAM DISCHARGE

and relatively free of boulders and aquatic growth. The flow should be uniform and free of eddies, dead water near banks, and excessive turbulence. Determine the width of the stream by stringing a measuring tape from bank to bank at right angles to the direction of flow. Next, determine the spacing or width of the verticals. Space the verticals so that no subsection has more than 10 percent of the total discharge. If the stream width is less than 5 ft, use vertical spacing widths of 0.5 ft. If the stream width is greater than 5 ft, the minimum number of verticals is 10.

To determine the mid-point of a cross section, for example, divide the cross section width in half, if the total stream width is 26 feet with 20 cross sections and each cross section width is equal to 1.3 feet. Divide 1.3 feet in half and the mid-point of the first section is 0.65 feet. In this example, the tape at waters edge is set at zero feet. By adding 0.65 to zero, the mid-point of the first section is 0.65 feet. Each subsequent mid-point is found by adding the section width (1.3 feet) to the previous mid-point. For example, the first mid-point = $0.65 + 0.0 = 0.65$ feet; the second mid-point = $0.65 + 1.3 = 1.95$ feet; the last midpoint = $24.05 + 1.3 = 25.35$ feet.

Stream discharge will be measured and calculated based on the Continuity Equation as follows:

$$Q = Av$$

Where:

- Q is the discharge (volumetric flow rate) measured in cubic feet per second (ft³/sec);
- A is the cross-sectional area of the wetted portion of the channel in square feet (ft²); and
- v is the average velocity of flow through the cross-section in ft/sec.

During each monitoring event, depth (i.e., stage) will be measured to an accuracy of ± 0.01 feet at one-foot intervals across each surveyed cross section. Velocity measurements will be made at the designated locations using a hand-held flow meter (i.e., Global Water Flow Probe, or equivalent). This device directly measures average velocity using a true digital running average to an accuracy of ± 0.1 ft/sec. Velocity will be measured at approximately 60 percent of the stage height across the entire width of the stream as conditions permit and the average velocity will be used in the continuity equation (above).

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STANDARD OPERATING PROCEDURE
MEASURING STREAM DISCHARGE

4.0 DOCUMENTATION

For each event, the field team will record the field data collected for stream flow on the form presented in Attachment A. The field team will note at a minimum: weather, stream and flow conditions, including evidence of stream gain or loss (e.g., debris eddies). In the event that surface water flow is non-existent or too low to measure, the sampling team will note as such on the form in Attachment A. The field team will also take photographs as necessary to document stream conditions.

5.0 SPECIAL NOTES

Appropriate HASP requirements should be considered in the surface water areas, including, if necessary, personal flotation devices, waders, and safety ropes. Two person teams, at a minimum, are required for measuring stream discharges.

Attachment 1 diagrams the appropriate use of cross sections for stream flow calculations.

Attachment 2 is an example of a field measurement form to be completed during measurement activities in order to document stream conditions.

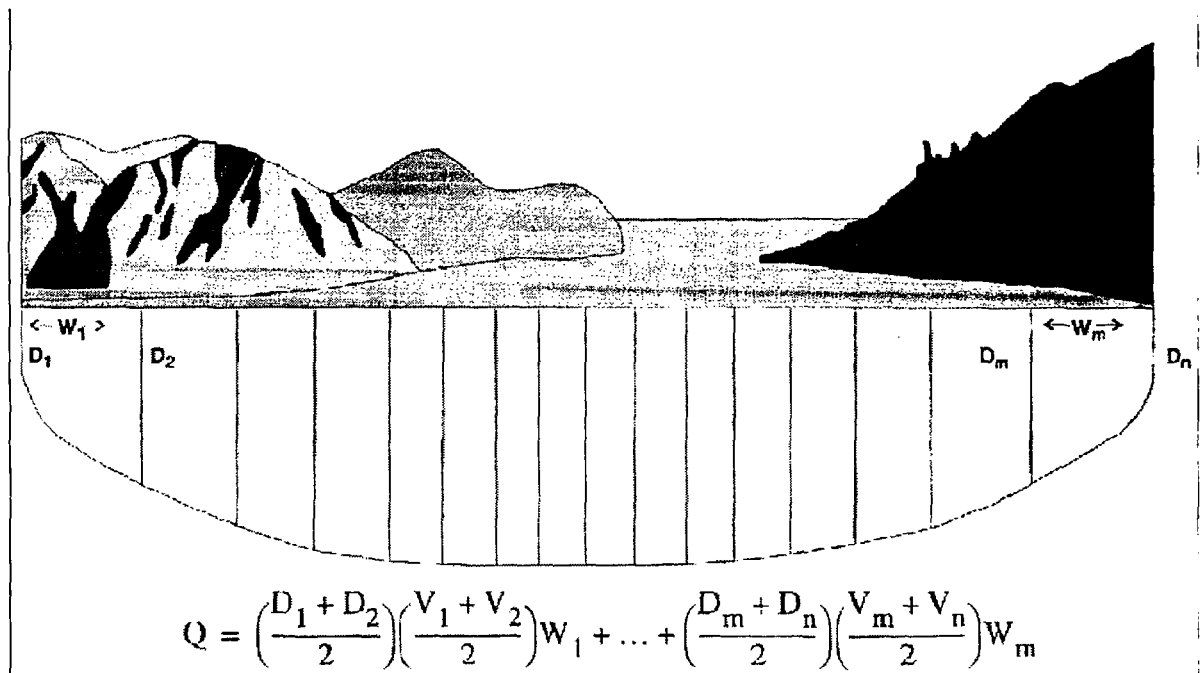
6.0 REFERENCES

United States Environmental Protection Agency Standard Operating Procedures for Stream Flow Measurements

SOP-6811
STANDARD OPERATING PROCEDURE
MEASURING STREAM DISCHARGE

Attachment 1

Stream cross section illustrating mid-section method to determine discharge
(USEPA SOP for Stream Flow Measurements).



Q = discharge, D = depth, V = velocity, W = width (Rantz and others, 1982)

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STANDARD OPERATING PROCEDURE
MEASURING STREAM DISCHARGE

Attachment 2. Field Form

Stream Flow Measurement Form

Project _____
Location _____
Weather _____
Sampling Personnel _____

Date	Time	Sampling Location	Total Depth of Water (ft)	Cross Sectional Area (ft)	Average Velocity (ft/s)	Discharge (ft ³ /s)	Samples Taken for Analyses

NF = No Flow meter reading, flow is too low.
Note if no flow evident or suspended sediment evident in stream.

Notes: _____

SOP-6812
STANDARD OPERATING PROCEDURE
SURFACE AND SHALLOW SUBSURFACE SOIL SAMPLING

1.0 **PURPOSE**

The purpose of this SOP is to describe the procedures that will be followed when collecting surface or shallow subsurface soil samples. The procedure describes recovery of surface and shallow subsurface samples from surficial soil using hand equipment.

2.0 **EQUIPMENT AND MATERIALS**

For sampling dry or saturated soil, sludge or sediment (surficial):

- Sampling spoon, trowel, or scoop (cleaned, and not plated or painted);
- Stainless steel mixing bowl or Teflon tray;
- Sample containers;
- Sampling gloves;
- Decontamination supplies; and
- Site-specific Health & Safety Plan (HASP).

3.0 **PROCEDURES**

3.1 **DISCRETE SAMPLES**

1. All sampling equipment will be decontaminated prior to use and between sample locations in accordance with the procedures specified in SOP No. 6819.
2. If a shallow subsurface sample is desired, the trowel or spade will be used to remove the top layer of soil to the desired sample depth.
3. If required for the samplers being used, plastic sampling sleeves will be inserted in all samplers before samples are recovered. The sleeves will be used once and then discarded in an appropriate container.

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STANDARD OPERATING PROCEDURE
SURFACE AND SHALLOW SUBSURFACE SOIL SAMPLING

4. A sampling device (e.g., spoon) will be used to remove the sample from the soil on the blade of the trowel or spade, avoiding the thin layer of soil from the area which comes in direct contact with the trowel or spade.
5. All depth intervals will be sampled with the appropriate core sampling device. The sample will then be transferred to the sample containers by pouring the sediments into the appropriate containers. If it is not possible to pour the sediments, a clean stainless steel spoon or spatula may be used to facilitate the transfer.
6. The sample container will be labeled with the appropriate information. All chain-of-custody documents will be completed and the appropriate information recorded in the field log book or report form.
7. The labeled sample container will be placed in an appropriate transport container with ice (if required) as soon as possible.
8. All sampling equipment will be decontaminated between sample locations in accordance with the procedures specified in SOP No. 6819.

3.2

COMPOSITE SAMPLES

Composite samples are typically comprised of samples from equivalent sediment depths at multiple locations. Discrete samples that make up a composite sample will be collected as described above; however, a stainless steel mixing bowl or Teflon tray will be used for mixing the discrete samples prior to placing the sample in the laboratory-supplied sample containers. Composite sampling is generally not recommended when samples are to be analyzed for volatile organics.

1. Composite samples, consisting of a pre-determined number of discrete samples, may be recovered using a soil recovery probe. Dedicated plastic sampling sleeves will be used for these composite samples. The probe will be driven to an appropriate depth, and a sample recovered from the appropriate depth at each sampling location.
2. The equal volume samples will then be composited by mixing in a stainless steel pan and then placed in a properly labeled laboratory container.

SOP-6812
STANDARD OPERATING PROCEDURE
SURFACE AND SHALLOW SUBSURFACE SOIL SAMPLING

3. Where exact mapping of sample locations is required, the discrete sample locations shall be marked in such a way that they can be properly mapped.
4. The sampling equipment shall be decontaminated between sampling zones in accordance with SOP No. 6819 (i.e., between areas represented by a composite sample).

4.0 DOCUMENTATION

Each sample container will be labeled as directed by the Project Work Plan or by the Project Manager and a chain-of-custody record will be completed. A field log book or other Field Data Sheet will be kept describing the sampling procedures, the sample locations, all sample identification numbers, and any deviations from this SOP. A map or site sketch will be constructed of all sample locations using field measurements (i.e., GPS) or from coordinates obtained from a qualified surveyor.

5.0 SPECIAL NOTES

The decontamination process will be repeated after each use and between all discrete sample locations (SOP No. 6819). If compositing strategies are used, decontamination may only be required between composite samples (i.e., not between discrete samples that form a single composite). Sample gloves shall be changed in between each location.

6.0 REFERENCES

SOP No. 6819: Decontamination of Sampling Equipment.

U.S. EPA. Characterization of Hazardous Waste Sites, A Methods Manual -Vol. II, Available Sampling Methods. 2nd Ed. 12/84. EPA/600/4-84/076.

SOP-6813
STANDARD OPERATING PROCEDURE
SURFACE WATER SAMPLING

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used in the collection and preparation of surface water samples. Strict adherence to these procedures shall help promote consistency in project sampling and to ensure sample integrity.

2.0 EQUIPMENT AND MATERIALS

- Meters, probes and standards for *in-situ* measurements;
- Appropriate quality control blanks. The type and number of blanks should be established with the Project Manager;
- Sample containers;
- Waders, personal floatation device (as appropriate);
- Flat-bottom boat (if necessary);
- PPE;
- Digital camera;
- GPS Unit;
- Field notebook; and
- HASP.

3.0 PROCEDURES

The following procedures shall be adhered to for the collection and preparation of all surface water samples. During each surface water sampling event, the collection of samples will begin at the downstream sampling locations and proceed progressively to the upstream locations. The designated sampling order (i.e., from downstream to upstream locations) will reduce the potential for cross-contamination of samples and excessive sediment in the water sample.

At each surface water sampling location where a sediment sample will also be collected, the surface water sample will be collected prior to collecting the sediment sample. The location of the sampling station should be identified and marked using a GPS receiver. The general location relative to permanent

SOP-6813
STANDARD OPERATING PROCEDURE
SURFACE WATER SAMPLING

landmarks should also be recorded in a logbook and the location marked in the field where appropriate.

At each location, the following water quality parameters will be measured in the field: dissolved oxygen, specific conductivity, temperature, salinity and pH. Measurements should be made approximately mid-depth in the water column.

Water quality measurements will be made using a YSI 600XL meter (or equivalent). Calibration of the meter will be completed following the instrument manufacturer calibration protocols. Measurements should be obtained in-situ when possible, otherwise measurements can be obtained by immersing the instrument probes in a container filled with water from each sampling location. The container used for field measurements will be decontaminated between sampling locations by rinsing the container three times with water obtained at the new sampling location prior to collecting the field measurements.

Samples will be obtained from one-half the stream depth at mid-channel, and at arm's length upstream of the torso of sampling personnel. The sample bottle shall be inverted, and lowered to one-half the water depth, and held at about a 45° angle with the mouth of the bottle facing upstream.

Sampling personnel shall not collect turbid or sediment-containing water, which could bias the sample results. If a laboratory supplied sample container contains a preservative added at the laboratory, then the sample will be collected from the water column using a new, clean glass container to collect the sample and transfer it into the pre-preserved laboratory container.

Sampling containers and appropriate preservatives are based on the analyses to be performed on each sample. Appropriate sample containers will be used for the analyses to be performed on each sample collected during this task.

4.0

DOCUMENTATION

All aspects of the surface water sampling will be recorded in a project field book. The following water quality parameters will be measured in the field: dissolved oxygen, specific conductivity, temperature, salinity and pH. In addition, sample location, site conditions, weather, any deviations from this SOP and any other pertinent information will be recorded.

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STANDARD OPERATING PROCEDURE
SURFACE WATER SAMPLING

5.0 ***SPECIAL NOTES***

Consult the project-specific HASP for any requirements regarding safety gear while sampling in or near surface water bodies. It is recommended that sampling be performed in two person teams.

6.0 ***REFERENCES***

United States Environmental Protection Agency Emergency Response Team
Surface Water Sampling Standard Operating Procedure 2013 June, 1994.

SOP-6814
STANDARD OPERATING PROCEDURE
MEASUREMENT OF WATER LEVELS

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used for the measurement of water levels. Strict adherence to these procedures shall help ensure consistency in measurement technique and greater accuracy.

2.0 EQUIPMENT AND MATERIALS

- Electric water level indicator;
- Decontamination equipment;
- Field notebook;
- Extra batteries;
- Indelible ink pen; and
- HASP.

3.0 PROCEDURES

The following procedures should be followed when collecting water level measurements. A permanent mark should be made on the top of the riser pipe or well casing to provide a point of reference for groundwater measurements. The measurement reference point should be documented in the field book.

Before a groundwater level measurement is made, groundwater should be given the opportunity to stabilize (minimum of 24 hours after well construction and development). All measurements should be made to an accuracy of 0.01 feet. All measuring equipment used as part of this task should be decontaminated prior to use and measurements should proceed, when possible, from the least contaminated to most contaminated well.

To collect the groundwater level measurement, remove the well cap and lower the electric water level indicator into the well until the water surface is reached as indicated by the audible or visual alarm on the measuring device. The distance from the water surface to the reference point should be recorded in the project field book. The reference point should also be noted (e.g. top of PVC, top of outer casing). For a depth to groundwater measurement, the length that the well casing protrudes above the ground surface should be subtracted from the

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MEASUREMENT OF WATER LEVELS

groundwater depth as measured from the reference point to provide a depth to groundwater below ground surface (bgs). Groundwater elevation can also be obtained if the casing is surveyed to provide accurate casing elevation data. Note that in some instances the water in the well may be under pressure (as evidenced by a suction sound when the cap is removed). It may be necessary to make multiple measurements over several minutes to determine the static water level.

4.0 **DOCUMENTATION**

Documentation of the measured depth to groundwater, reference measuring point, weather conditions, site conditions, any limiting conditions (monitoring point inaccessibility, etc.) and any deviations from this SOP will be maintained in the field book.

5.0 **SPECIAL NOTES**

None.

REFERENCES

None.

SOP-6815
STANDARD OPERATING PROCEDURE
WELL EVACUATION

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used to evacuate a monitoring well.

2.0 EQUIPMENT AND MATERIALS

- Electronic water level indicator/graduated depth sounder;
- Pocket calculator;
- Site-specific Health & Safety Plan (HASP); and
- Well excavation equipment, including the following:
 - For two-inch diameter wells where the depth to water is greater than 25 feet, a Fultz, small-diameter submersible pump will be used for well evacuation.
 - A small-diameter bailer may be used to evacuate two-inch wells where a low volume of water must be purged from the well, and when the well is likely to be completely evacuated before three well volumes are purged. Bailers are not recommended for purging when volatile organics are the primary, or only, constituents of concern.
 - Bottom-loading PVC, stainless steel, or Teflon bailers can be used to obtain a ground water sample after the well has been evacuated.

3.0 PROCEDURES

Prior to evacuating the well, it will be necessary to determine the volume of water being held in the well casing. The calculation of the well volume will be conducted as follows:

1. Measure the well casing's inside diameter.
2. Determine the static water level, measured to the nearest 0.01 foot below the measuring point evaluation. The top of the casing will be used as the measuring point and marked to standardize its location. It should be

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noted that the water level indicator must be cleaned before use in each well.

3. Determine the total depth of the well from the measuring point.
4. Calculate the number of linear feet of static water (total depth of the well minus the static water level).
5. Calculate the static volume in gallons (7.48 gallons per cubic foot) in accordance with:

$$\text{Volume} = \pi \times r^2 \times h$$

where:

$\pi \approx 3.14$;

r = radius of well in feet; and

h = number of lineal feet of static water.

In most cases, removal of three well volumes will ensure the collection of a representative sample not influenced by stagnant water remaining in the well casing, and yet not result in over-pumping of the well. The latter can cause diluted or more concentrated groundwater from another area within the aquifer to be introduced into the well. If the well is completely evacuated during extraction, it will be permitted to recover and then be re-evacuated, if possible, until at least one and one-half volumes are purged.

On subsequent sampling events, the purging method, flow rate, relative purge volume, and percentage of recovery should be standardized at a given well. This will help ensure that the data obtained will be comparable from one sampling event to the next.

3.1

VOLUME-BASED PURGING, LOW-FLOW PURGING, AND BAILING

The purpose of purging is to evacuate stagnant water that may be present in the well column and filter pack and introduce representative formation water into the well casing. Purging is completed using a variety of bailers and/or pumps, which are described below. The Project Manager will determine the most appropriate purging method. The device selected to purge the well is dependent

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upon the well construction and hydraulic conditions of the screened interval. The selected purging device will provide an adequate discharge rate without producing a negative effect on ground water quality.

3.1.1 *Volume-based Purging*

The U.S. EPA recommends that three to five well volumes be purged from a well in order to obtain a representative ground water sample. Typically, indicator field parameters (pH, temperature and conductivity) stabilize within the period that monitoring wells are purged of three well volumes. In some cases, dissolved oxygen and ORP readings may also be required to document stabilization. Occasionally, it is advisable to purge less than three well volumes (e.g., in conditions where excessive purging may cause contaminant migration or if minimal purge volume technology such as low flow sampling is employed). Furthermore, more than three well volumes will be purged in cases where indicator field parameters have not stabilized. Under these conditions, the well will be purged until the temperature, conductivity and pH of the purge water have stabilized, or up to five well volumes (unless the FSAP or Project Manager specifies that more than five well volumes will be purged). The temperature, pH, and conductivity will be measured initially, as well as after each well volume is purged. The last two values obtained must be within ten percent of one another. The values will be recorded in the field logbook or on the appropriate field data sheet.

The pH meter will be calibrated using a 2-point curve with pH buffer solutions that bracket the suspected ground water pH. Conductivity will be calibrated using a commercially available standard in accordance with manufacturer's instructions and recommendations. Operation and maintenance of the pH/temperature and conductivity meters will also be in accordance with the manufacturer's instructions and recommendations. Note that some projects will require that meters be used to measure dissolved oxygen and ORP after every well volume is removed. Where required, these meters will be calibrated and operated in accordance with the manufacturer's specifications. Low yielding wells, from which at least three well volumes cannot be removed, will be completely evacuated before sampling. All wells will be sampled within 24 hours of purging. If a sample cannot be obtained after the initial purging, multiple trips to the well with less than 24 hours between trips will be made in accordance with applicable regulations.

To reduce the possibility of error, purge and well volumes will be calculated in the field based on a conversion factor that represents the gallons of water in the

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well per foot of standing water. Typical conversion factors used are listed in the table below:

Volume per Linear Foot of Standing Water

Well Diameter	Cubic Feet	Gallons
2.0	0.022	0.16
4.0	0.087	0.65
6.0	0.196	1.47
8.0	0.349	2.61

The following formula was used to determine the conversion factors:

$$\text{Gallons/feet of water} = C \times (\pi \times d^2 / 4 \times 1 \text{ feet})$$

Where: $\pi = 3.1416$,

d = diameter of well casing (feet),

C = 7.48 (constant for converting feet³ to gallons).

Then the volume to be purged will be:

$$V = (\text{gallons/ft. of water}) \times L \times n$$

Where: V = volume to be purged (gallons),

L = column of standing water in well (feet),

n = number of well volumes to be removed (typically three to five).

3.1.2 *Bailing*

Depending on the hydraulic characteristics, depth, and recharge rate of an individual well, bailing may be applicable method for well purging. Bailers used during this operation will be constructed of PVC, stainless steel, Teflon, or other acceptable materials. The Project Manager will specify the bailer materials based on known geochemical conditions at the site and regional regulatory variances. If dedicated bailers are installed in the wells, they will be used for both purging and sampling unless otherwise authorized by the Project Manager.

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When using this purging technique, a new rope will be attached to the bailer when purging each well, unless the rope is dedicated with the dedicated bailer. The bailer will be slowly lowered into the water column to prevent excessive agitation of fines and to prevent aeration of the ground water. The well will be bailed from the top of the water column to the bottom. When the bailer is full, it will be retrieved and the contents carefully transferred into a holding container of known volume to determine the purge volume (e.g., five-gallon bucket). All water removed during purging will be assumed contaminated unless analytical data have been obtained that indicate otherwise. Purge water will be stored on-site and properly disposed of as directed by the Project Manager.

3.2 GROUND WATER PUMPS

In some cases, factors such as depth to water, total depth of the well, and/or well diameter make the use of a bailer inefficient. In these instances, the use of pumps will be employed to maximize the efficiency of purging. Any pump used will be properly decontaminated prior to purging, in accordance with SOP No. 6819. The use of any pump to purge a well will be carried out in accordance with the manufacturer's instructions.

1. Submersible Pumps

Submersible pumps provide an effective means of well purging for deep wells. Submersible pumps are particularly useful in situations where the depth to water is greater than 20 feet, or where the depth or diameter of the well requires that a large volume of water be removed.

These pumps will only be used with approval of the Project Manager for purging operations and will generally not be used for the collection of ground water samples.

2. Foot-Valve Lift Pump (e.g., Waterra™)

In some instances, where wells are difficult to access, a foot-valve lift pump (e.g., Waterra™) will be used. A foot valve is attached to the end of semi-rigid tubing and lowered into the well. The tubing is then moved up and down at a constant rate to allow water to flow through the column of tubing. Once the correct amount of water is purged, the valve shall be removed and the tubing discarded. A new piece of tubing will be used in each subsequent well. The valve will be decontaminated according to SOP No. 6819.

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3. Peristaltic Pumps

Peristaltic pumps typically provide a low rate of flow in the range of 0.02 - 0.2 gpm. For this reason, these pumps will be suitable for purging situations where recharge rates are low and/or disturbance of the water column must be kept at a minimum. This method may be employed for particularly sensitive analyses or to avoid introduction of excessive fine material.

4. Low Volume Dedicated Purge Pumps

Dedicated pumps are useful in situations where the excavation of very large volumes of water from wells/piezometers are in equilibrium and representative ground water samples can be collected prior to purging of three well volumes. Their design allows smaller purge volumes than might be required with conventional pumps. Ground water samples may also be collected from these types of pumps.

These pumps will only be used with approval of the Project Manager for purging and sampling operations. In many cases, a disposable polyethylene bailer sized for two-inch inside-diameter wells will be used when sampling each well. Acceptable sample collection equipment includes a disposable bailer, dedicated bailer, or properly-decontaminated Teflon, stainless steel, or other acceptable bailer. A spool of nylon, polypropylene, or other acceptable rope will be used as the bailer cord. If a Teflon or stainless steel bailer will be reused, it will be properly decontaminated in accordance with SOP No. 6819 prior to use in each well. The bailer cord will then be attached to the bailer and the bailer knot tested to ensure that the knot and all parts of the bailer are securely intact prior to lowering into the well.

As an alternative to sampling with a bailer, low-flow purging (as described above) and sampling may be conducted. All reusable down-hole equipment (e.g., tubing, submersible pump, etc.) will be properly decontaminated in accordance with SOP No. 6819 before being lowered into the well.

3.3 **SAMPLE ACQUISITION**

The following procedure will be used for obtaining ground water samples from monitoring wells:

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1. If a bailer has been used to purge the well, a previously cleaned second bailer must be used to obtain the sample.
2. Whenever possible, before any samples are collected, the well must be allowed to recover so that there is sufficient water in it to collect all the necessary sample volume. It is extremely important that whatever instrument is used to check the depth to water be thoroughly decontaminated before being used in the well between purging and sampling.
3. The bailer used for collecting the sample will be lowered into the well, retrieved, and emptied once to ensure that the bailer has been rinsed of any decontamination fluids if a stainless steel bailer is used.
4. When collecting the ground water sample, the bailer should be gently lowered sufficiently into the water column to collect a sample unaffected by equilibration with the atmosphere (approximately ten feet, if possible), jerked gently to ensure that the ball valve is closed, and retrieved at a steady rate to the surface.
5. When transferring the water from the bailer to the sample containers, care must be exercised to avoid agitating the sample, which would promote the loss of volatile constituents and promote chemical oxidation.
6. If a Teflon® or stainless steel bailer is not dedicated to a specific well, it must be thoroughly decontaminated between wells. Again, all equipment and materials contacting the inside casing of the well or the ground water must be decontaminated between use (see SOP No. 6819).

4.0 *DOCUMENTATION*

All field observations will be recorded in a field notebook as outlined by SOP No. 6828.

5.0 *SPECIAL NOTES*

None.

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6.0

REFERENCES

SOP No. 6819: Decontamination of Field Sampling Equipment.

SOP No. 6828: Field Notebook.

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STANDARD OPERATING PROCEDURE
GROUND WATER SAMPLE COLLECTION

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that will be followed during the collection of representative ground water samples from monitoring wells/piezometers.

2.0 EQUIPMENT AND MATERIALS

- Portable photoionization detector (PID) or flame ionization detector (FID);
- Multi-gas meter (i.e., O₂, CH₄, percent LEL, percent gas) or equivalent(s);
- Interface probe or water level indicator with a tape graduated to 0.01 ft;
- Submersible pump, bladder pump, peristaltic pump, foot-valve lift pump, or positive displacement piston pump;
- Power source (e.g., generator), if an electric pump is used;
- Dedicated or reusable bailer constructed of Teflon, stainless steel, disposable polyethylene, or other acceptable material;
- Tubing constructed of polyvinyl chloride, polypropylene, polyethylene, stainless steel or other suitable materials sized appropriate for the pump discharge;
- Polypropylene rope or other suitable bailer cord;
- pH/temperature meter;
- Conductivity meter;
- Dissolved oxygen meter;
- Storage container for purge water;
- Field Notebook;
- Calibrated container with a capacity of at least five gallons;
- Sample gloves (latex, vinyl, or other suitable material); and
- Site-specific Health & Safety Plan (HASP).

As an alternative to standard purging and sampling techniques, low-flow sampling may be conducted. Besides equipment and materials listed above (e.g.,

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peristaltic or submersible pumps, tubing, etc.), the following additional equipment will be required for low-flow sampling:

- Flow-through cell capable of continuously monitoring field indicator parameters during purging and sampling;
- Turbidity meter (optional); and
- A graduated cylinder.

3.0 PROCEDURES

As the monitoring well piezometer is approached, a visual inspection of the conditions will be completed and documented. If warranted in the site-specific Health & Safety Plan (HASP), the ambient air conditions in the vicinity of the wellhead will be documented prior to its opening. The PID or FID will be used to determine if any significant concentrations of volatile organic compounds (VOCs) are present in the ambient air near the well. After screening for VOCs, the appropriate meter(s) will be employed to measure percent LEL and percent O₂ and determine if explosive or oxygen deficient conditions exist in the vicinity of the wellhead. These screening measurements will be conducted at heights and distances from or in the wellhead as directed by the Project Manager, or as described in the site-specific HASP.

If either screening method indicates conditions above action levels are present, the area will be immediately evacuated until the situation can be reevaluated. In any case, the sampling team will make a concerted effort to perform all ground water sampling procedures upwind from the wellhead.

After the environment in the vicinity of the wellhead is deemed satisfactory, the well will be opened and the air conditions in the well column determined, if specified in the site-specific HASP. The protective casing of the well/piezometer will be unlocked and the cap will be accessed. After removal of the cap, the air quality in the riser will be screened (as applicable) and the findings will be documented. If warranted, the PID or FID probe will be inserted approximately six inches into the well column for accurate determination of VOC concentrations. After completing an assessment for VOCs, the appropriate meter(s) may be employed to determine percent LEL, percent O₂ or other gases, to determine conditions within the well column.

If either screening method indicates conditions above action levels, the area will be immediately evacuated and appropriate actions taken.

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The monitoring well will be allowed to stabilize prior to collecting water level measurements using a water level meter or an interface probe. The interface probe or water level indicator will be decontaminated in accordance with SOP No. 6819 prior to collecting water level measurements.

All measurements (as described below) will be taken from the survey mark indicated on the top of the well casing. If a mark is not already indicated, the north position of the casing should be used as the measurement point. This point should then be marked for future reference.

If there is the potential for the presence of non-aqueous phase liquid (NAPL) in the well, a determination of the presence and thickness of immiscible layer(s) will be conducted in accordance with the probe manufacturer's instructions. Care will be taken so that the interface probe and tape do not touch the well casing as they are lowered into the well. The probe will be slowly lowered until the top of fluids is encountered. The interface probe will emit a continuous tone if NAPL is encountered or an intermittent tone if water is encountered. The tape will be slowly raised and lowered to determine the exact measurement (within 0.01 feet). If there is the presence of dense (i.e., heavier than water) NAPL, the probe will be lowered to the bottom of the well. Measurements will be recorded in the field notebook or on the appropriate field data sheet. After the measurements are complete, the probe and all measuring tape lowered into the well will be thoroughly decontaminated in accordance with SOP No. 6819.

A water level probe is used to measure water levels; the probe will be slowly and carefully lowered into the well column until the water level is encountered. The water level indicator will emit an audible signal when it makes contact with water. The tape will be slowly raised and lowered to determine the exact measurement (within 0.01 feet). After the water level measurement procedure is complete, the probe and the portion of the measuring tape that was lowered into the well will be thoroughly decontaminated in accordance with SOP No. 6819. The measurement will be recorded in the field notebook or on the appropriate field data sheet.

The monitoring well/piezometer can now be purged. The purpose of purging is to evacuate stagnant water that may be present in the well column and filter pack and introduce representative formation water into the well casing. Purging is completed using a variety of bailers and/or pumps, which are described below. The Project Manager will determine the most appropriate purging method. The device selected to purge the well is dependent upon the well construction and hydraulic conditions of the screened interval. The selected

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purging device will provide an adequate discharge rate without producing a deleterious effect on ground water quality.

3.1 VOLUME-BASED PURGING

The U.S. EPA recommends that three to five well volumes be purged from a well in order to obtain a representative ground water sample. Typically, indicator field parameters (pH, temperature and conductivity) stabilize within the period that monitoring wells are purged of three well volumes. In some cases, dissolved oxygen and ORP/eh readings may also be required to document stabilization. Occasionally, it is advisable to purge less than three well volumes (e.g., in conditions where excessive purging may cause contaminant migration or if minimal purge volume technology such as low flow sampling is employed). Furthermore, more than three well volumes will be purged in cases where indicator field parameters have not stabilized. Under these conditions, the well will be purged until the temperature, conductivity and pH of the purge water have stabilized, or up to five well volumes (unless the FSAP or Project Manager specifies that more than five well volumes will be purged). The temperature, pH, and conductivity will be measured initially, as well as after each well volume is purged. *The last two values obtained must be within ten percent of one another.* The values will be recorded in the field logbook or on the appropriate field data sheet.

The pH meter will be calibrated using a 2-point curve with pH buffer solutions that bracket the suspected ground water pH. Conductivity will be calibrated using a commercially available standard in accordance with manufacturer's instructions and recommendations. Operation and maintenance of the pH/temperature and conductivity meters will also be in accordance with the manufacturer's instructions and recommendations. Note that some projects will require that meters be used to measure dissolved oxygen and ORP after every well volume is removed. Where required, these meters will be calibrated and operated in accordance with the manufacturer's specifications. Low yielding wells, from which at least three well volumes cannot be removed, will be completely evacuated before sampling. All wells will be sampled within 24 hours of purging. If a sample cannot be obtained after the initial purging, *multiple trips to the well with less than 24 hours between trips* will be made in accordance with applicable regulations.

To reduce the possibility of error, purge and well volumes will be calculated in the field based on a conversion factor that represents the gallons of water in the

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well per foot of standing water. Typical conversion factors are listed in the table below:

Volume per Linear Foot of Standing Water

Well Diameter	Cubic Feet	Gallons
1.0	0.0054	0.04
2.0	0.022	0.16
4.0	0.087	0.65
6.0	0.196	1.47
8.0	0.349	2.61

The following formula was used to determine the conversion factors:

$$\text{Gallons/feet of water} = C \times (\pi \times d^2 / 4 \times 1 \text{ feet})$$

Where: $\pi = 3.1416$,

d = diameter of well casing (feet),

$C = 7.48$ (constant for converting feet^3 to gallons).

Then the volume to be purged will be:

$$V = (\text{gallons/ft. of water}) \times L \times n$$

Where: V = volume to be purged (gallons),

L = column of standing water in well (feet),

n = number of well volumes to be removed (typically three to five).

3.2

LOW FLOW PURGING

As an alternative to purging based on volume, low-flow water extraction may be utilized to purge the well. The pump will be carefully lowered in the well to avoid disturbing sediment that may have settled in the bottom of the well. The pump's intake will be situated within the screened interval by convention, halfway between the top and bottom of the screen; however, site-specific conditions may warrant setting the intake above or below the halfway point.

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Pumping will then be initiated, with the flow adjusted such that little or no water level drawdown is measured within the well — U.S. EPA generally recommends keeping the flow rate below 200 ml/min. to avoid aeration of the water. Indicator field parameters will be measured and recorded until stabilization occurs. EPA recommends that the basis for stabilization is three consecutive readings, taken within three to five minute intervals, which fall within the following limits:

- Turbidity (10% for values greater than 1 NTU);
- DO (10%);
- Specific conductance (3%);
- Temperature (3%)
- pH (± 0.1 unit); and
- ORP (± 10 millivolts).

There is a wide variety of equipment and acceptable procedures for well purging.

3.3

BAILING

Depending on the hydraulic characteristics, depth, and recharge rate of an individual well, bailing may be applicable method for well purging. Bailers used during this operation will be constructed of PVC, stainless steel, Teflon, or other acceptable materials. The Project Manager will specify the bailer materials based on known geochemical conditions at the site and regional regulatory variances. If dedicated bailers are installed in the wells, they will be used for both purging and sampling unless otherwise authorized by the Project Manager.

When using this purging technique, a new rope will be attached to the bailer when purging each well, unless the rope is dedicated with the dedicated bailer. The bailer will be slowly lowered into the water column to prevent excessive agitation of fines and to prevent aeration of the ground water. The well will be bailed from the top of the water column to the bottom. When the bailer is full, it will be retrieved and the contents carefully transferred into a holding container of known volume to determine the purge volume (e.g., five-gallon bucket). All water removed during purging will be assumed contaminated unless analytical

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data have been obtained that indicate otherwise. Purge water will be stored on-site and properly disposed of as directed by the Project Manager.

3.4 GROUND WATER PUMPS

In some cases, factors such as depth to water, total depth of the well, and/or well diameter make the use of a bailer inefficient. In these instances, the use of pumps will be employed to maximize the efficiency of purging. Any pump used will be properly decontaminated prior to purging, in accordance with SOP No. 6819. The use of any pump to purge a well will be carried out in accordance with the manufacturer's instructions.

A. Submersible Pumps

Submersible pumps provide an effective means of well purging for deep wells. Submersible pumps are particularly useful in situations where the depth to water is greater than 20 feet, or where the depth or diameter of the well requires that a large volume of water be removed.

B. Check-Valve Lift Pump (e.g., Waterra™)

In some instances, where wells are difficult to access, a check-valve lift pump (e.g., Waterra™) will be used. A foot valve is attached to the end of semi-rigid tubing and lowered into the well. The tubing is then moved up and down at a constant rate to allow water to flow through the column of tubing. Once the correct amount of water is purged, the valve shall be removed and the tubing discarded. A new piece of tubing will be used in each subsequent well. The valve will be decontaminated according to SOP No. 6819.

C. Peristaltic Pumps

Peristaltic pumps typically provide a low rate of flow in the range of 0.02 - 0.2 gpm. For this reason, these pumps will be suitable for purging situations where recharge rates are low and/or disturbance of the water column must be kept at a minimum. This method may be employed for particularly sensitive analyses or to avoid introduction of excessive fine material.

D. Low Volume Dedicated Purge Pumps

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Dedicated pumps are useful in situations where the excavation of very large volumes of water from wells/piezometers are in equilibrium and representative ground water samples can be collected prior to purging of three well volumes. Their design allows smaller purge volumes than might be required with conventional pumps. Ground water samples may also be collected from these types of pumps.

These pumps will only be used with approval of the Project Manager for purging and sampling operations. In many cases, a disposable polyethylene bailer sized for two-inch inside-diameter wells will be used when sampling each well. Acceptable sample collection equipment includes a disposable bailer, dedicated bailer, or properly-decontaminated Teflon, stainless steel, or other acceptable bailer. A spool of nylon, polypropylene, or other acceptable rope will be used as the bailer cord. If a Teflon or stainless steel bailer will be reused, it will be properly decontaminated in accordance with SOP No. 6819 prior to use in each well. The bailer cord will then be attached to the bailer and the bailer knot tested to ensure that the knot and all parts of the bailer are securely intact prior to lowering into the well.

As an alternative to sampling with a bailer, low-flow purging (as described above) and sampling may be conducted. All reusable down-hole equipment (e.g., tubing, submersible pump, etc.) will be properly decontaminated in accordance with SOP No. 6819 before being lowered into the well.

It should be noted that the bailer cord should never touch the ground surface or the protective well casing at any time during the sample collection process. If the bailer cord cannot be prevented from touching the ground, protective plastic sheeting may be placed around the well area to prevent rope from contacting the ground.

During sample collection, the bailer will be slowly lowered into the well to prevent agitation of the water to minimize the volatilization of any VOCs. The bailer will then be slowly and smoothly raised to the surface in a manner that will not agitate the sample.

The contents will be transferred into the appropriate containers and preserved in accordance with the specified analytical method. Samples will be collected in order of decreasing volatility (i.e., volatiles, semivolatiles, metals, etc.). Sample bottles will be properly labeled in accordance with the relevant plans for the project.

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As an alternative to sampling with a bailer, the low-flow technique may be used to collect samples. Samples may be collected from a bypass assembly prior to water entering the flow-through cell or from the discharge of the flow-through cell. If the sample is collected from the flow-through cell, the flow-through cell will be included in the equipment blank sample collection process. To the extent possible, the tubing should remain water-filled while directing water into sample containers. Care will be taken so that minimal turbulence/aeration occurs during transfer of water from the tubing into sample containers.

All sample containers will be placed on ice as soon as possible after collection. Samples should remain at 4°C until analysis.

Finally, materials for sample collection will be either properly disposed of, or in the case of reusable equipment, will be properly decontaminated per with SOP No. 6819.

4.0

DOCUMENTATION

A number of documents may be completed and maintained as part of the ground water sampling effort. The documents should provide a summary of the sample collection procedures and conditions, shipment method, analyses requested and the custody history. Below is a list of the items and documents that should be completed:

- Field notebook
- Ground Water Monitoring Well Field Data Sheets (Figure 1)
- Sample labels (Figure 2)
- Chain-of-Custody records (Figure 3)
- Daily Field Reports
- Request for analysis sheets

All pertinent data including, but not limited to, the type of purging device, the volume purged, pH, conductivity, temperature, and any other relevant information will be recorded in the field notebook or on the appropriate data sheet. Any deviation from the above-described procedures will be performed only with prior approval of the Project Manager.

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5.0 ***SPECIAL NOTES***

See manufacturer's instructions for specific notes on various equipment and materials used in the collection of ground water samples from monitoring wells/piezometers.

6.0 ***REFERENCES***

SOP No. 6819: Decontamination of Sampling Equipment.

Puls, Robert W. and Michael J. Barcelona, U.S. EPA. Low-flow (Minimal Drawdown) Ground-water Sampling Procedures. Ground Water Issue, EPA/540/S-95/504, April 1996.

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Figure 2. Example Sample Labels

ANALYSIS ONLY - NO FIELD USE 60th Street Landfill Site	LOT# 0312501R	
	SAMPLE ID	
	SAMPLED BY	DATE
		TIME
	LOCATION	PRESERVATIVE
	ANALYSIS	CLIENT
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ANALYSIS ONLY - NO FIELD USE 60th Street Landfill Site	LOT# 0312501R	
	SAMPLE ID	
	SAMPLED BY	DATE
		TIME
	LOCATION	PRESERVATIVE
	ANALYSIS	CLIENT
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ANALYSIS ONLY - NO FIELD USE 60th Street Landfill Site	LOT# 0312501R	
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ANALYSIS ONLY - NO FIELD USE 60th Street Landfill Site	LOT# 0312501R	
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SOP-6817
STANDARD OPERATING PROCEDURE
SAMPLING LEACHATE SEEPS

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used for sampling leachate seeps. These procedures are the recommended sampling procedures for all leachate seep locations in order to provide for consistent sampling technique. Strict adherence to these procedures shall help ensure consistent sampling of all leachate.

2.0 EQUIPMENT AND MATERIALS

- pH, temperature, and conductivity meters, probes and standards for *in-situ* measurements;
- Appropriate quality control blanks. The type and number of blanks should be established with the project manager;
- Flow and velocity estimation devices;
- Sampling devices. These will include the use of the sample containers and a telescoping aluminum pole with an attached beaker known as a grab sampler. A boat will be used to sample surface waters (and sediment); however, where the streams become inaccessible it may be appropriate to sample while wading. Note that stagnated areas in streams or rivers might contain zones of contaminant concentration.;
- PPE;
- Digital camera;
- GPS Unit;
- Field notebook; and
- HASP.

3.0 PROCEDURES

Should seeps be identified during field activities, a sample of the overburden water that seeps onto the ground surface should be collected. A small temporary berm will be constructed or a stainless steel bowl will be used to pool ground water at seep locations. A grab sample will be collected by using a peristaltic pump or sample jar to collect the pooled groundwater. Seep samples will be analyzed for parameters including VOCs, SVOCs and PCBs. If possible, after

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STANDARD OPERATING PROCEDURE
SAMPLING LEACHATE SEEPS

sample collection the pH, temperature and conductivity of the seep water will be measured and recorded using a YSI 600XL (or equivalent) meter. The location of the sampling station should be identified and marked using a GPS receiver. The general location relative to permanent landmarks will be recorded in a logbook.

4.0 *DOCUMENTATION*

All aspects of the leachate sampling event will be recorded in a project field book. Water quality parameters, as available, will be measured in the field and recorded in the project field book. In addition, sample location, site conditions, weather, deviations from this SOP and any other pertinent information will be recorded.

5.0 *SPECIAL NOTES*

Consult the Site-Specific HASP before entering any areas where soft ground may be present.

6.0 *REFERENCES*

SOP No. 6813 Surface Water Sampling

SOP-6818
STANDARD OPERATING PROCEDURE
SEDIMENT SAMPLING

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used for the collection of sediment samples. Sediment sampling within the on-site streams, and at select upstream and downstream locations, will discern whether there are Site-related exposures contributing to ecological risks. Because the streams are part of a larger urban watershed, information will be required relative to upstream conditions for each stream. Locations will be selected based on physical depositional characteristics (particle-size distribution in the sediment). Strict adherence to these procedures shall help ensure sample integrity even if delivery is delayed.

2.0 EQUIPMENT AND MATERIALS

The selection of sediment sampling equipment will be based on project requirements, distance from the shore, and water depth. Depending on location-specific characteristics, surface sediment samples will generally be collected from zero to 5 cm. In addition, the 5 to 15 cm and 15 to 30 cm depth ranges may be collected and assessed at select stations.

3.0 PROCEDURES

Sediment sampling should be performed in teams of two or more persons. The following are general procedures to be followed when collecting sediment samples.

1. Identify the sampling location and document it in the field book.
2. Pre-label sample containers. Use a water-proof marker and include sample number, location, date collected, and initials of sampler.
3. Fill plastic wash bottles with water from outside the boat.
4. Wear appropriate safety (e.g., flotation vests) and protective gear (e.g., gloves, boots, and glasses).

The following provides additional discussion relating to the above procedures. The location of the sampling station should be identified and marked using a GPS receiver. The general location relative to permanent landmarks and the grid location will be recorded in a logbook.

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Sediment sampling will begin at the most downstream sampling station and proceed upstream to avoid contaminating downstream samples with suspended fines from upstream. Samples will be taken from a workboat or by wading. If sampling from a boat, the boat will be positioned upstream of the sampling location where the anchor will be dropped from the bow and used to position and hold the stern of the boat at the sampling station. If wading, the sampling station will be approached from the downstream side in order to prevent contamination by suspended sediments from upstream.

Samples will be taken from up to the top 30 cm of sediment using the selected sampling device. At each sampling station, multiple sub-samples will be taken and homogenized into a representative composite sample. To do so, a stainless-steel spoon will be used to transfer up to the top 30 cm of sediment from the sampling device into a stainless steel mixing bowl. The sub-samples will then be thoroughly mixed using the spoon: this becomes the composite sample.

Between each sampling station, the sampling device, spoon, and mixing bowl will be decontaminated to prevent transfer of contamination from one sampling station to another.

Collect sediment samples (i.e., 0 - 5 cm depth) at identified sediment locations and for a select set of stations also collect sediment cores (i.e., 5 - 15 cm and 15 - 30 cm depths) for chemical and physical analyses. Surface sediments co-located with the samples collected for bulk sediment chemistry analysis will be collected and stored for potential future sediment toxicity testing (SOP 6824) should the testing be required based on the screening analyses. These surface samples will be obtained using grabs (e.g., either an Eckman™ or Ponar™ sampler) and the top 2 inches (approximately 5 cm) will be used to form the sample volume needed for toxicity testing.

The surface sediment for bulk chemistry and potential future toxicity testing will be drawn from a composite of multiple grabs at each sediment sampling station. Due to sensitivity to disturbance, an Acid Volatile Sulfide - Simultaneously Extractable Metals (AVS-SEM) sample will be drawn from the first grab, prior to compositing.

At each sediment sampling location, the sediment will be probed to evaluate the potential for scour. In addition, depth to refusal will be assessed for possible use in the human health risk assessment.

In order to avoid cross-contamination and chemical disturbance (e.g. AVS-SEM), the order of sample collection at a location will be: surface water meter readings,

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STANDARD OPERATING PROCEDURE
SEDIMENT SAMPLING

surface water chemistry, sediment core, sediment grab composites (i.e., with the first grab supplying the AVS-SEM sample), and qualitative sediment grab samples.

At each location, water quality parameters may also be measured in the field.

3.1 *EQUIPMENT SPECIFIC PROCEDURES*

This section describes the methods used to obtain representative sediment samples from lentic surface-water bodies, such as ponds, lakes and reservoirs, using several types of sampling equipment:

- Ekman Grab Sampler
- Petite Ponar Grab Sampler
- Ogeechee Sediment Corer
- Hand Auger

3.1.1 *Ekman Grab Sampler*

The Ekman grab sampler is designed to obtain sediment samples in soft, finely divided littoral bottoms that are free from vegetation and inter-mixtures of sand, stones, and other coarse debris. The Ekman sampler performs particularly well in those water body bottoms composed of finely divided muck, mud, ooze, submerged marl, or fine peaty material. The Ekman is composed of a stainless steel box with a pair of spring-tensioned, scooped jaws mounted on pivot points on opposite sides of the box. The jaws are held open by stainless steel wires that lead to an externally mounted trigger assembly. If the Ekman is being used for sampling in deep water, it is mounted on a line and dropped through the water to the sediment. A steel messenger is then attached to the line and dropped to activate the trigger assembly. If the Ekman is being used for sampling in shallow water, it is mounted onto an extension pole. The extension pole has an internal rod which is pressed from the end opposite the Ekman to activate the trigger assembly.

Procedure:

- Load the jaws by placing the wire loops onto the trigger assembly pegs, causing the springs to be tensioned.
- Deploy the Ekman with open jaws.

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SEDIMENT SAMPLING

- When the operator believes that the Ekman has penetrated the bottom sediment, activate the closure mechanism of the jaws.
- Slowly retrieve the Ekman by extracting slowly.
- Remove and transfer the sediment from the Ekman into a stainless steel bowl.

3.1.2 *Petite Ponar Grab Sampler*

The petite ponar grab sampler (Ponar) consists of a pair of weighted, tapered jaws, each of which are attached to a catch bar, joined at a pivot point to allow for the jaws to close when activated. On touching the bottom, the tension of the bar is released, causing a springed, set pin to pop out and allow the catch bars to hinge and close the Ponar. The Ponar is closed by lifting the cable or rope attached to the opposite end of the catch bars from the jaws. The jaws of the Ponar overlap to minimize sample washout during the ascent of equipment. The upper portion of the jaws are covered with a mesh screen and rubber flap, allowing water to pass through the Ponar during descent, reducing disturbance at the sediment-water interface by a shock wave.

Procedure:

- Set the jaws of the Ponar in the open position by using the catch bars on the top of the Ponar.
- Insert the springed, released pin through the holes in both of the catch bars.
- Lower the Ponar slowly under the water surface to avoid premature triggering upon impact with the water surface. Once in the water, the Ponar can be lowered to the bottom, when the line should be slack.
- Tug the line gently three times to ensure that the mouth of the Ponar is squarely set on the bottom and that the jaws are open.
- To retrieve the Ponar, pull the line up at a constant speed, hand-over-hand. The tension on the cable will retract the jaws.
- Open the Ponar and allow the sediment to discharge into a stainless steel bowl.

3.1.3 *Ogeechee Corer*

The Ogeechee corer was designed to sample firm or sandy bottoms. The corer is attached to an extension that allows for both twisting and downward pressure to

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SEDIMENT SAMPLING

work together in order to obtain a long core sample. The corer itself consists of a hollow metal pipe two inches in diameter (the core barrel). Polyurethane core liners, or tubes, fit into the core barrel and retain the sediment sample. An equipment blank of the core liner must be analyzed prior to sampling to determine whether the liners leach organic contaminants into the sample. A closing valve inside the head assembly of the core barrel is opened and closed by the operator using a closing line attached to the valve. The valve opens and allows water to flow through the barrel during descent. Upon penetration of the corer into the sediment, the sampler closes the valve, thereby preventing the sediment from sliding out of the core barrel during retrieval. A cutter head is mounted on the end of the core barrel to achieve better and deeper penetration into the sediment. During retrieval, a metal core catcher is inserted into the cutting head to prevent loss of the sediment.

Procedure:

- Insert the core liner into the barrel.
- Insert a core catcher into the core liner.
- Mount the core cutting head onto the barrel.
- Open the valve at the top of the barrel to allow unrestricted water flow when lowering the corer into the water.
- Lower to sediment surface and push into sediment vertically.
- When the operator believes that the corer has penetrated the bottom sediment, close the valve using the closing line to create a partial vacuum inside the core tube during the retrieval of the corer.
- Retrieve the corer by pulling up slowly.

(It should be noted that several attempts may be necessary to collect a representative sediment core. If upper sections of the coring device emerge covered with fine-grained sediments upon the sample retrieval, the speed of entry was too rapid. If a sloping surface of the sediment in the core liner is found, the corer penetrated at an angle, and a second attempt should be made.)

- Remove the sediment sample from the apparatus, following these steps:
- Remove the core liner from the core barrel.
- Decant the water slowly from the top of the core liner.

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- Remove the core catcher from the liner, allowing the sediment representing the deepest portion of the core in the core liner to slowly empty from the liner until the upper two inches of core remain.
- After the first core is collected, empty the upper two inches of the core directly into the pre-labeled sample containers for VOC analysis. When collecting additional sediment cores for the remaining chemical analyses and sediment toxicity testing:
- Empty the upper two inches of the collected core into a stainless steel mixing bowl until a large volume of sediment representing the upper two inches from several cores is collected.
- Homogenize the sediments in the stainless steel pan.
- Fill the sample containers with the homogenized sediments and place in coolers with ice.
- When all sample containers are filled for that location, decontaminate the core barrel, core liner and core catchers.

3.1.4 Hand Auger

The hand auger is comprised of a four-inch diameter stainless steel barrel with two ramped, sharpened cutting teeth. The hand auger is mounted onto one or more four-foot extension rods. When rotated, the teeth bite into the sediment and pull the barrel downward. It is used for sampling highly consolidated sediment, such as clay, where grab samplers are unable to penetrate the sediment surface.

Procedure:

- Attach the hand auger to as many extension sections as required to reach the sediment.
- Lower the hand auger to the sediment surface.
- Turn the hand auger clockwise, allowing for the auger to bury itself into the sediment rather than pushing it into the sediment.
- When the operator believes that the core has penetrated to the desired depth, slowly pull the auger from the sediment.
- Slowly retrieve the hand auger through the water column.
- Place the auger into a stainless steel bowl and spoon the desired sediment out.

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SEDIMENT SAMPLING

3.2 *EQUIPMENT DECONTAMINATION*

Field personnel should first change all PPE that will come in contact with the equipment being decontaminated and rinse all visible debris (i.e., sediment, leaves, twigs, etc.) from the equipment using site water. Decontamination procedures are further discussed in SOP-6819. After the equipment is decontaminated, wrap the equipment in aluminum foil, with the dull side of the foil touching the equipment, if it will not be used immediately.

4.0 *DOCUMENTATION*

All aspects of the sediment sampling will be recorded in a project field book. The following water quality parameters should be measured in the field: dissolved oxygen, specific conductivity, temperature, salinity and pH. In addition, sample location, site conditions, weather, and deviations from the above SOP and any other pertinent information will be recorded.

5.0 *SPECIAL NOTES*

Consult the project-specific HASP documents for safety hazards for working in and near surface water bodies.

6.0 *REFERENCES*

SOP No. 6819: Decontamination of Sampling Equipment.

United States Environmental Protection Agency Emergency Response Team *Soil Gas Sampling Standard Operating Procedure* 2016 November, 1994.

SOP-6819
STANDARD OPERATING PROCEDURE
DECONTAMINATION OF FIELD EQUIPMENT

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that will be followed when decontaminating field equipment. The equipment may include split spoon soil samplers, bailers, trowels, shovels, hand augers, drilling rigs, or any other type of reusable equipment employed during field investigations.

Decontamination will be performed as a both a quality assurance measure and as a safety precaution. Specifically, the purpose for these decontamination procedures is to minimize the potential for cross contamination between sampling locations and prevent potentially contaminated materials from being transported off-site.

2.0 EQUIPMENT AND MATERIALS

- High-pressure steam cleaner;
- Cleaning fluids: non-phosphate soap and/or detergents, potable water, distilled/deionized water, isopropyl alcohol, nitric acid (dilute);
- Shovels and brushes;
- Paper towels;
- Disposable gloves;
- Waste storage containers: plastic bags, drums, boxes;
- Cleaning containers: plastic buckets, etc.;
- Plastic sheeting;
- Personal protective equipment; and
- Site-specific Health & Safety Plan (HASP).

3.0 GENERAL

1. All decontamination will be performed under the assumption that the equipment is contaminated. At a minimum, clean, unused vinyl, nitrile, or latex gloves will be worn during all decontamination activities. Additional personal protective equipment will be worn as necessary.

SOP-6819
STANDARD OPERATING PROCEDURE
DECONTAMINATION OF FIELD EQUIPMENT

2. An adequate supply of all decontamination equipment and materials should be available on site.
3. All equipment will be decontaminated prior to use on-site and before leaving the site.
4. Decontamination of vehicles or large equipment will generally be conducted in a designated area. Smaller equipment may be decontaminated at the sampling location.
5. All decontamination materials that cannot be re-used will be properly packaged for disposal based on the nature of contamination.

4.0 **PROCEDURES**

The following sections present the minimum procedures that will be used to decontaminate field equipment. If different or more extensive procedures are required, they will be pre-approved by the Project Manager, Quality Assurance Officer, and regulatory agencies.

4.1 **DRILLING RIG AND ASSOCIATED EQUIPMENT**

1. All equipment coming in contact with potential contamination, both as part of subsurface equipment advancement and above-ground contact with drilling fluids, extracted soils, ground water, drill rig lubricants and fuels, etc., will be decontaminated prior to use. At the discretion of the Project Manager, decontamination of the entire drilling rig may be required due to the adherence of foreign substances as a result of operations, transportation from off-site, or travel between soil boring locations.
2. A high-pressure steam cleaner will be used to clean the inside and outside of drilling equipment that will not come into contact with test samples (e.g., augers). Decontamination of sampling equipment (e.g., macrocore samplers, split-spoon samplers) is described in Section 4.2.
3. All liquid and solid material produced from this operation will be collected and properly contained until such time as it can be sampled and properly disposed of.

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STANDARD OPERATING PROCEDURE
DECONTAMINATION OF FIELD EQUIPMENT

4. The date, time, and decontamination procedure used will be recorded on the boring log, daily field report or in a field notebook.

4.2 SOIL SAMPLING EQUIPMENT (SPLIT SPOONS, TROWELS, MACROCORE DIRECT-PUSH EQUIPMENT, ETC.)

Sampling equipment will be decontaminated between sample locations and sample intervals to minimize the potential for cross-contamination.

1. The sampler will be completely disassembled and any adhered soil will be removed.
2. The sampler will be placed in a bucket containing a non-phosphate soap and water (e.g., Liquinox™) and scrubbed until visibly clean. The soap and water will be changed as necessary.
3. The sampler will then be thoroughly rinsed with potable water until all soap solution is removed. All rinse water will be collected and containerized.
4. In some instances it may be necessary to perform an additional wash with isopropyl alcohol or dilute nitric acid (for metals removal). Typically, washes with methanol or nitric acid are performed using a spray bottle.
5. The sampler will be reassembled and given a final rinse with distilled/deionized water.
6. If the sampler is not to be used immediately it must be stored in a location or manner that will prevent it from becoming re-contaminated.

4.3 GROUND WATER PUMPS

This procedure will be employed to decontaminate the non-dedicated pumps that are used during well purging, development, and sampling operations.

1. Any dedicated tubing that was used with the pump will be removed and properly discarded.
2. All exterior surfaces will be wiped with clean paper towels and any extraneous materials will be removed using a stiff brush.

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STANDARD OPERATING PROCEDURE
DECONTAMINATION OF FIELD EQUIPMENT

3. The pump and all associated down-hole equipment will be placed in a suitably sized container of non-phosphate soap (e.g., Liquinox™) and potable water. If the tubing on the pump is to be re-used, the pump will be turned on to circulate the solution through the pump and tubing.
4. In some instances it may be necessary to perform an additional wash with isopropyl alcohol or dilute nitric acid (for metals removal). Typically, washes with methanol or nitric acid are performed using a spray bottle.
5. The pump will then be thoroughly rinsed with potable water. If the tubing on the pump is to be reused then the pump will be turned on until the internal portions of the pump and tubing are free of cleaning solution. The last rinse applied to the pump system will always be distilled water.
6. The pump and associated down-hole equipment will be properly stored to ensure that the system remains clean during transportation to other well heads. The pump will not be allowed to come in contact with the ground at any time during handling and transportation. If this occurs, the pump and associated down-hole equipment will be recleaned.
7. All liquids and waste materials produced during this operation will be properly stored and disposed of as determined by the Project Manager.

4.4

BAILERS

This section documents the procedures that will be followed to decontaminate non-dedicated bailers used for purging or sampling ground water.

1. The bailer will be scrubbed with non-phosphate soap and water solution. The inside of the bailer will be scrubbed with a cylinder brush to ensure that interior walls are thoroughly cleaned.
2. The bailer will be rinsed with potable water until it is free of the soap solution.
3. In some instances it may be necessary to perform an additional wash with isopropyl alcohol or dilute nitric acid (for metals removal). Typically, washes with methanol or nitric acid are performed using a spray bottle.
4. A final rinse of distilled water will then be applied.

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STANDARD OPERATING PROCEDURE
DECONTAMINATION OF FIELD EQUIPMENT

5. The bailer will be properly stored if it is not to be immediately used. To properly store the bailer, the entire bailer will be placed in its dedicated storage tube or wrapped in inert material (e.g., Saran wrap, aluminum foil, etc.).
6. All liquids and waste materials produced during this operation will be properly stored and disposed of as determined by the Project Manager.

4.5 WELL CASING AND SCREEN PRE-INSTALLATION DECONTAMINATION PROCEDURES

New well pipe and screen will be used for all well installations. Typically well materials arrive at the site in factory packaging. In some instances, the well construction materials may require cleaning to remove dust or soil that may have deposited on the material, if the packaging was damaged. This section documents the procedures, if necessary, that will be followed to decontaminate well construction materials prior to installation. The following procedures apply to both PVC and Type 304 stainless steel casing (if used) and screen materials. The on-site scientist/geologist will determine if well materials will require cleaning to ensure the integrity of future samples.

1. All personnel handling the well materials must wear clean and unused vinyl or latex gloves.
2. The well casing and screen will be removed from the packaging. The well materials will be placed on clean sawhorses or equivalent support devices. The well materials will be washed with a clean stiff brush and a non-phosphate soap (e.g., Liquinox™) and water solution.
3. The well materials will then be rinsed with potable water.
4. A high pressure steam cleaner may then be used to thoroughly remove any remaining soap or soiled areas.
5. The final step will be to rinse the well materials with distilled water. the well materials will remain on the saw horses until well construction commences.

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STANDARD OPERATING PROCEDURE
DECONTAMINATION OF FIELD EQUIPMENT

4.6 ***INTERFACE PROBE AND WATER LEVEL INDICATOR***

The entire length of the probe and tape that was inserted into the well will be decontaminated by washing with a non-phosphate detergent (e.g., Liquinox™) and then rinsing with distilled water.

5.0 ***DOCUMENTATION***

The procedure(s) employed, date(s), and time(s) will be recorded on the appropriate documentation (e.g., daily field reports, field notebooks, boring logs, etc.). Any deviation from these procedures must be noted. Deviations must be approved by the Project Manager and Quality Assurance Officer.

6.0 ***SPECIAL NOTES***

None

7.0 ***REFERENCES***

None

SOP-6820
STANDARD OPERATING PROCEDURE
SOIL GAS PROBE INSTALLATION

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used to install soil gas probes to allow for soil gas sample collection. These procedures are recommended for use at all soil gas probe locations to provide for consistent and accurate soil gas probe installation. Strict adherence to these procedures shall help ensure the proper collection and integrity of the soil gas sample.

2.0 EQUIPMENT AND MATERIALS

- Direct push coring equipment;
- Geoprobe implants (or similar sampling points);
- Sampling point cap;
- Sand or glass beads;
- Bentonite and grout; and
- Plastic sheeting (or equivalent).

3.0 PROCEDURES

The following procedures shall be adhered during the installation of all soil gas sampling probes. The installation of soil-gas monitoring points will consist of a Geoprobe Stainless Steel Implant placed into the subsurface vadose zone with a maximum depth of 5 feet which can be monitored thereafter through tubing extending to the ground surface. Teflon or Teflon-lined tubing will be attached to a Geoprobe screen implant (or similar) and placed down the soil boring to the appropriate depth. The soil boring will then be backfilled with clean sand or glass beads to approximately ½ foot above the screen. The remainder of the borehole will be backfilled with bentonite, that will be hydrated as appropriate. The surface of the installation should be sealed with bentonite and grout, and covered for protection. A 2" PVC cover may be inserted into the cement and flagged to ensure that the monitoring point is visible. The intent is that these monitoring points will allow measurements of the concentrations of gas accumulating in the soil voids. The implants will remain in the ground to permit subsequent sampling on a periodic basis throughout the remedial investigation. The points will be marked in the field and the location as read from the GPS will be recorded in the field book.

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STANDARD OPERATING PROCEDURE
SOIL GAS PROBE INSTALLATION

After installation, a small amount of soil vapor will be purged from the probe to adequately flush the sample probe and line. The subsurface vapor points will then be capped to ensure no moisture enters the tubing, and allowed to equilibrate at least overnight prior to sampling.

4.0 DOCUMENTATION

Field documentation will be maintained in the project field book recording, at a minimum, the site and weather conditions observed at the time of the soil gas probe installation, subsurface conditions observed at the time of installation and any deviations from the above protocol.

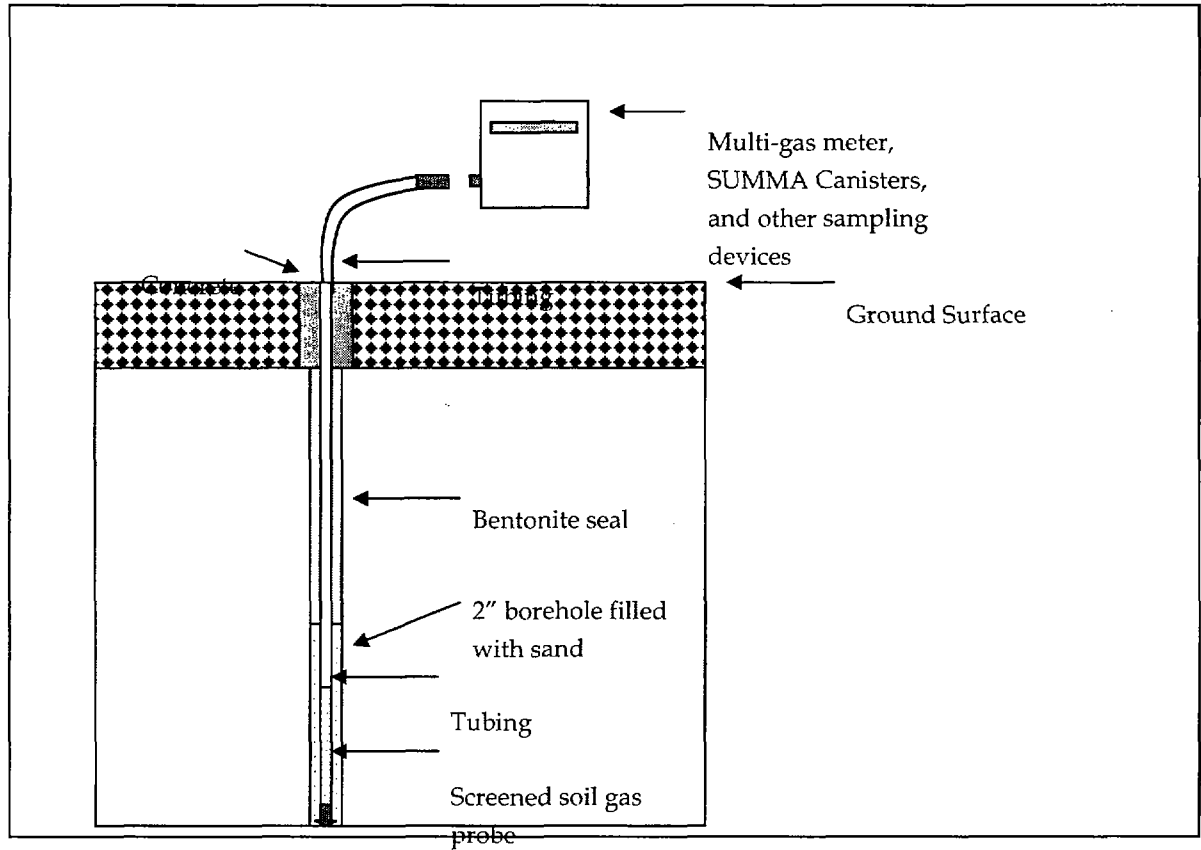
5.0 SPECIAL NOTES

Figure 1 is a design schematic of a soil-gas monitoring point.

6.0 REFERENCES

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STANDARD OPERATING PROCEDURE
SOIL GAS PROBE INSTALLATION

Figure 1. Subsurface soil gas sampling schematic.



SOP-6822
STANDARD OPERATING PROCEDURE
SOIL GAS SAMPLE COLLECTION

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used during the collection of soil gas samples. These procedures are the recommended handling procedures to be used during all soil gas sampling in order to provide consistency in sample collection technique. Strict adherence to these procedures shall help ensure that the soil gas sampling results in meaningful and accurate data.

2.0 EQUIPMENT AND MATERIALS

- Sample canister (SUMMA canister or similar);
- Sample inlet line (collection tubing);
- Plastic sheeting (or similar) to protect sampling device;
- Gas Alert Micro 5 PID (or similar) multi-gas meter;
- Field notebook; and
- HASP.

3.0 PROCEDURES

At the beginning and end of each day the temperature and barometric pressure at the site will be recorded. Each sampling point will be analyzed in the field for methane and basic gas composition (oxygen, nitrogen, carbon dioxide), after which, samples may be obtained using Summa canisters for laboratory analysis of the gaseous constituents. After receiving the canister from the laboratory, and prior to sampling, the pressure in the canister should be measured and recorded to ensure that the appropriate negative pressure exists within the sample container. Screening of hydrocarbons may be performed using a PID or FID meter.

The evacuated canister is fitted with a flow regulator which is then opened to the atmosphere containing the VOCs to be sampled (i.e., connected to the soil-gas tubing). Sample duration is typically from 8 to 24 hours; however, grab samples with 10 to 30 second durations are also commonly collected. The sample duration is dependant upon the degree to which the flow is restricted by the flow regulator. Plastic sheeting or similar protective material can be spread across the

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STANDARD OPERATING PROCEDURE
SOIL GAS SAMPLE COLLECTION

sampling area during the sampling duration to provide protection for the sampling equipment and to shelter the sampling point from inclement weather.

Upon completion of the desired sample duration the canister valve should be closed and a final canister pressure should be recorded. A full scan (TO-15) of volatile constituents will be evaluated in the laboratory in addition to the replication of the field parameters. The weather conditions and barometric pressure during the field investigations will also be documented.

4.0 DOCUMENTATION

Field documentation will be maintained in the project field book recording, at a minimum, the site and weather conditions observed at the time of the soil gas sample collection, the sample duration, the beginning and ending canister pressures and any deviations from the above protocol.

5.0 SPECIAL NOTES

Duplicate samples will be collected from a single soil-gas implant affixed with a "Y" connection that has two tubes that connect to separate SUMMA canisters or other sampling devices.

6.0 REFERENCES

United States Environmental Protection Agency Emergency Response Team *Soil Gas Sampling Standard Operating Procedure* 2042 June, 1996.

SOP-6824
STANDARD OPERATING PROCEDURE
BIOLOGICAL SAMPLE COLLECTION

1.0 PURPOSE

The purpose of this SOP is to describe the procedures for the collection of biological samples. Biological sampling and analyses include a reconnaissance survey and follow-up sampling events that are comprised of fish collection, qualitative benthic survey, and the collection of samples for sediment toxicity testing. Strict adherence to these procedures shall help ensure proper and consistent biological sample collection.

2.0 EQUIPMENT AND MATERIALS

- Electro-shocking equipment,
- Scientific gill nets,
- Hoop nets,
- Other gear utilized by local fishermen (i.e., waders),
- Digital camera,
- Ruler,
- Scale,
- Forceps,
- Aluminum foil and/or zip-loc bags,
- Indelible pens and labels,
- Field notebook, and
- Site-specific Health & Safety Plan (HASP).

3.0 PROCEDURES

Biological sampling and analyses include a reconnaissance survey and follow-up sampling events that are comprised of fish collection, qualitative benthic survey and the collection of samples for sediment toxicity testing. SOPs for each of these tasks are described below.

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STANDARD OPERATING PROCEDURE
BIOLOGICAL SAMPLE COLLECTION

3.1 RECONNAISSANCE

A reconnaissance survey will be used to refine the Fish Sampling Program. This survey will be conducted by a team comprised of a wildlife biologist and an aquatic biologist. The field observations will be used to finalize sampling methodology and determine the number of biota samples that can be realistically collected in the main sampling event. The objectives and justification for the reconnaissance survey activities are described below:

- Establish the list of selected representative receptor species that are using the terrestrial, wetland, and surface water habitats and represent assessment endpoints for the baseline ecological risk assessment. The selected species will represent different feeding groups such as fish-eating birds and herbivorous mammals.
- Identify predominant shoreline and upland vegetation.
- Select upstream reference locations. The appropriateness of these potential reference areas should be evaluated during the reconnaissance survey. A fish habitat evaluation form will be used to evaluate the various locations.

A habitat assessment will be used to document the physical and environmental conditions for each of the upland areas and each of the runs above, through and below the Site. In addition, parameters pertinent to the assessment of the benthic habitat will be considered when selecting a reference area. These include: bottom substrate, available cover, estimation of embeddedness, and estimation of the flow or velocity and depth regime. Additional parameters include the channel morphology and riparian and bank structures such as bank stability, bank vegetation, and streamside cover. The observations should be recorded (either in a field book or on habitat field data sheets).

The reconnaissance survey will include qualitative observations of:

- Benthic invertebrate organisms identified in sediments in the runs. These observations will be used to determine the sampling strategy for these organisms with respect to taxa.
- Aquatic vegetation in the water bodies. Observations will be made along the banks of the runs. The types of submergent, emergent and floating aquatic vegetation will be documented.

Photographs should be obtained at all locations selected for sampling prior to collecting any biota from the runs.

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3.2 **FISH COLLECTION**

Fish samples will be collected to meet two objectives:

- 1) Identification of predominant species; and
- 2) Evaluation of the levels of bio-accumulative compounds in tissues.

The equipment to be used for fish collection can include gill and seine nets. The selection of specific fish collection equipment will be based on the distance from the shore, and the water depth. The selected equipment will be employed for a standard length of the water body or for a standard period of time. The species type, fraction sampled (i.e. whole body or fillet), preservation methods, shipment methods and storage methods should be detailed in the Management Area-Specific Work Plans. However, some specifics are described herein.

The fish selected for analysis will be submitted as whole fish samples to the analytical laboratory. Filleting and other preparation of the fish will occur in the laboratory and not in the field. Samples will be analyzed as fillet, offal, or whole fish sample. Criteria for the selection of fish for analysis include feeding strategies (trophic levels) as well as size.

The goal of the sampling effort is to collect at least five fish from each trophic category and from each of the areas for tissue analysis. Because they can be small, forage fish will be analyzed as composites of individuals. It is recognized that this goal may be difficult to meet because a trophic category may not be present, or fewer than five fish may be collected. In this case, the effort will focus on those fish that are collected within each of the target categories. If no piscivorous fish are obtained, large individuals of the sunfish species (e.g., bluegills), or catfish, will be substituted for this category. This substitution is relevant since some humans consume larger sunfish and catfish.

3.2.1 **General Procedure for Fish Collection**

- Before any sampling activity, the sampler operators will don site-specific personal protective equipment, as required in the Health and Safety Plan.
- The fish collection equipment will be deployed in accordance with the manufacturer recommendations or other widely accepted technique. The locations at which nets or traps are set will be marked using a GPS receiver. The locations from which fish are successfully taken will also be marked with a GPS receiver.

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- The fish retained for analysis will be logged on a Fish Sample Log sheet, which includes an assigned identification number, species, length, weight, and observation of external pathology. External pathology includes visible lesions, tumors, or other sores.
- All fish samples will be placed in zippered plastic bags and stored on ice or dry ice for shipment to the analytical laboratory.

3.2.2 *Fish Sampling Devices*

3.2.2.1 *Gill Nets*

Gill nets are comprised of a weave of fine filament designed to trap fish by their gills when the fish swim through the nets. The top of the net is equipped with floats, and the bottom of the nets has lines onto which weights are tied; the amount of weight used varies depending on the range of depth that the gill net must cover. The ends of the gill net are held in place by anchors and buoys.

Gill nets are deployed and remain in the water for 1 to 2 hours. They are not set for extended periods of time or overnight; serious injury and death could be inflicted upon large numbers of fish and other wildlife in this instance.

3.2.2.2 *Seine Nets*

Seine nets are comprised of a woven filament net with handles at either end. Seines are most commonly deployed while wading. The net is dragged through the water by its handles, keeping the bottom of the handle slightly in front of the top, and onto the shore where the fish are collected.

3.2.2.3 *Electro-Shocking Equipment*

Electro-shocking equipment uses an electrical current generated by a portable generator and transmitted through a hand-held or boat-mounted anode to electrify the water. The electrical current temporarily stuns fish or causes them to roll and become visible to personnel, who then collect the fish with dip nets. Electro-shocking requires insulated waders, gloves, nets, and other equipment to prevent the personnel from being shocked. Electro-shocking would only be considered if other methods of fish sample collection are unsuccessful.

3.3 *Collection of Benthic Community Samples*

Benthic community samples will be obtained at the sediment sampling locations designated for qualitative analyses. These collections are not used to compare

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areas with respect to potential impacts since this would be difficult given the heterogeneity of this particular environment. Rather, these samples will be used to understand the types of benthic receptors present throughout the study area. These qualitative samples will be obtained at selected sampling stations in the runs above, within, and below the Site. Because these samples are for qualitative purposes only, one sample will be obtained at each location for identification of taxa. Two possible sampling methods will be employed, depending on habitat:

- 1) Grab samples will be used where sediments are comprised of silts and sands; and
- 2) Surber samples will be used where sediments are comprised of gravel, rocks, and debris.

Habitat conditions at each of the sample locations will be evaluated in the field and by several of the analytical measurements in the laboratory. At each station the following will be determined: physical characteristics of sediments (field observations and particle-size distribution analysis), organic content of sediments (field observations on the nature of the sediments and laboratory measurements of total organic carbon), water depth, stream flow velocity (estimated in the field), width of the water body, characteristics of the shoreline, bordering vegetation, and the extent of overhanging vegetation. Observations for the Habitat Assessment will be guided by the "Habitat Assessment Field Data Sheet-Low Gradient Streams", USEPA Rapid Bioassessment Protocols, 1989.

3.3.1 *Grab Samples for Collection of Invertebrates*

Sediments for the benthic community analysis are sampled using an Ekman or Ponar grab sampler. The selection of a grab sampler is based on the depth, current, and sediment type present at the location. The upper four inches of sediment will be sampled.

At each location, a standard volume of sediment will be collected and sieved using a standard 600 micron sieve. Any material remaining on the sieve will be placed into a labeled sample jar. The jar will then be filled with a 95% ethanol preservative. A tongue depressor labeled with the sample identification will be added to the sample, the jar will be sealed, and the lid will be secured with tape. The sample will be logged on a chain-of-custody record and placed in a cooler.

If the grab sampler is not being decontaminated as part of a sediment sampling protocol, it will be rinsed using Site water between replicates.

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3.3.2 *Surber Sampler for Collection of Invertebrates*

A surber sample will be employed in areas where there are cobbly bottoms or where there is much debris that makes it difficult to use a grab sampler. Use of this method is described in the "Rapid Bioassessment Protocol" (RBP) derived from Barbour, et al., 1999. The RBP was designed as a standard method for assessing the biological assemblages in lotic water systems. Benthic macroinvertebrate communities will be sampled from the Site, upstream, downstream, and in reference areas. The samples will be submitted to an analytical laboratory where the organisms will be identified and counted. A d-frame dip net will be used for areas too deep for the Surber. Because the survey is qualitative, a single sample will be collected from each location.

Sample locations will be selected to be representative of the project area being evaluated (i.e. Site, upstream, downstream, reference, etc.). To do so, the project area will be delineated and the approximate proportion of habitat types (riffle, run, pool) is measured. Samples will be obtained from areas that represent the largest proportions of habitat types for that reach.

The samples will be preserved by completely covering them with 95% ethanol. A tongue depressor labeled with the sample identification will be added to the sample, the jar will be sealed, and the lid secured with electrical tape. The sample will be recorded on a chain-of-custody record and placed in a cooler.

3.4 **SEDIMENT TOXICITY TESTING**

Sediment will be collected at selected sediment stations for use in sediment toxicity tests. This sampling will be coordinated with the sampling for sediment chemistry so that synoptic samples are used for chemistry, particle-size distribution, and toxicity. This allows the results to be more directly related. Sediment toxicity tests estimate toxicity by exposing one or more laboratory test species to field-collected sediment in a controlled laboratory setting under standard protocols. Results are evaluated using statistical comparisons of data between the test sediment and laboratory control and/or reference site sediment.

The selection of sample locations will be made during the reconnaissance survey. Key criteria for selection are substrate type and pore water salinity. Salinity measurements at the time of sampling will be used to determine the appropriate test species.

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A composite sample will be compiled from the upper two inches of sediment at each designated location by combining multiple grab samples. This composite will be of sufficient volume to support the evaluation of toxicity, particle-size distribution, and chemistry. The sample will be well mixed before allocating the sediment to the different analyses. A clean scoop will be used to transfer the sediment sample from the mixing bowl to the sample container. Non-representative material (e.g., stones, wood chips) will be removed from the sample at the discretion of the field sampler and will be documented in the field log. Approximately 3.5 liters of sediment per location will be collected and placed into clean, wide-mouth glass jars, labeled, and placed on ice in a cooler. Samples will be provided to the laboratory within 24 hours. At the laboratory, sediment samples used for toxicity testing will be refrigerated to 4° C and protected from light prior to testing in order to maintain the integrity of the original sediment.

4.0 **DOCUMENTATION**

All major aspects of the biological sampling event will be recorded in a project field book including sample location, site conditions, weather and any other pertinent information. In addition, any deviation from this protocol will be documented.

5.0 **SPECIAL NOTES**

None.

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6.0

REFERENCES

United States Environmental Protection Agency, Methods for Assessing the Toxicity of and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition, Method 100.4 (EPA/600/R-99/064)

United States Environmental Protection Agency, Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates, (EPA/600/R-94/024)

United States Environmental Protection Agency, Rapid Bioassessment Protocols, Habitat Assessment Field Data Sheet-Low Gradient Streams, 1989.

SOP No. 6818: Sediment Sampling

SOP-6826
STANDARD OPERATING PROCEDURE
CHAIN-OF-CUSTODY

1.0 PURPOSE

This SOP documents the chain-of-custody (COC) procedures that will be employed during all sampling activities.

2.0 EQUIPMENT AND MATERIALS

- Indelible ink ball-point pens;
- Chain-of-custody records (see attached Figure 1); and
- One-gallon size Ziploc (or equivalent) storage bags.

3.0 GENERAL

A completed COC record must accompany every sample from the point of collection to delivery to the laboratory. A single COC record may accompany several samples as long as all the samples are contained in a single unit (e.g., the same cooler, box, etc.). If a single COC is to be used for multiple samples in multiple coolers then a photocopy of the original COC must be placed in each cooler. All COCs will be kept in one-gallon Ziploc bags to prevent damage from melting ice, broken samples, and bad weather. A copy of every completed COC record will be retained in the project files.

4.0 PROCEDURES

4.1 COMPLETION OF COC RECORD

1. The COC record is initiated in the field by the sampler(s) immediately after a sample is collected. Figure 1 illustrates a properly completed COC.
2. The sample identification number will be recorded on the COC. Each sample number consists of three distinct data fields. A space for each data field is provided on the COC. These data fields include: project number, sample location, and sample type & ID.

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3. The number of containers that makes a complete sample will be recorded in the box labeled "No. of Cont.". A sample may consist of multiple containers depending upon the analytical procedures requested.
4. If the sample is to be analyzed for metals, the box labeled "Metals" shall be completed to indicate whether the sample fractions for metals have been filtered. An "F" will be used to indicate that the metals were filtered and an "N" will indicate that they were not filtered. Occasionally, some samples may require metal fractions to be filtered and not filtered (e.g., analyses for dissolved and total metals). In this case a "B" will be used to indicate that the sample contains both filtered and non-filtered fractions. If the sample does not require analyses for metals or is not applicable to filtering (i.e., solid sample) a single line will be drawn through this box.
5. The date and time (military) of sample collection will be recorded in the box labeled "Sampling Date/Time". It is very important to note the exact time each sample was collected.
6. The requested analytical methods will be recorded in the diagonal spaces provided under the box labeled "Analyses". The analytical method should always be referenced. Generalized descriptions such as "Metals" are not acceptable unless they reference a specific list (i.e., RCRA metals, Priority Pollutant List metals, etc).
7. Any preservatives added to the containers for each analytical method will be indicated by recording the letter in the box labeled "Preservatives" that corresponds to the preservative added. The preservatives and corresponding letters are listed near the top of the COC record.
8. A check mark or an "X" will be made under each fraction for which a particular sample will be analyzed. Drawing a line down the column or using quotes is not acceptable.
9. Any comments relating to the collected sample(s) can be recorded in the box labeled "Comments". These comments may indicate special handling or analytical instructions for the laboratory (e.g., compositing instructions, confirm MTBE, etc.) or may be used to indicate the location of sample collection.
10. Additional information required on the COC record includes the person the analytical reports should be sent to, client name, site name/location, project description, project number and phase, names of all samplers

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involved in sample collection, where the samples are to be delivered, method of delivery, and air bill number (if applicable).

4.2 TRANSFER OF CUSTODY

The COC record must document the transfer of custody each time the sample(s) change(s) hands. The National Enforcement Investigations Center (NEIC) of the EPA defines custody as:

1. The sample is in your physical possession;
2. The sample is within view after being in your physical possession;
3. The sample was in your possession and then you locked it or sealed it to prevent tampering; and/or
4. The sample is placed in a designated secure place with limited access to authorized personnel only.

When transferring custody of samples, the person in custody (e.g., the sampler) must sign the box labeled "Relinquished By" and fill in the date and time (military time) the custody of the samples was relinquished. The person accepting custody of the samples must then sign the box labeled "Received By" and complete the date and time (military time) the custody of the samples was accepted.

The above procedures must be followed until the samples are delivered to the laboratory. Both internal (within the same organization) and external (between different organizations) transfers need to be documented. In cases where a commercial courier (e.g., Federal Express) is used to deliver the samples, the person relinquishing custody to the courier should put the name of the courier in the 'Received By' box and seal the COC inside the cooler. Most couriers have a policy against signing for custody of samples.

The pink copy (bottom) of the COC will be retained by the sampler before the samples are shipped and the remaining copies (white and yellow) of the COC are delivered to the laboratory. The pink copy will then be immediately given to the QAO. The white copy will be returned by the laboratory with the final report.

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CHAIN-OF-CUSTODY

5.0 DOCUMENTATION

Chain-of-custody record.

6.0 SPECIAL NOTES

If samples are shipped via commercial courier on Friday the air bill needs to be checked for Saturday delivery.

Sample cooler packing instructions are documented in SOP No 6827.

If samples are known to contain flammable or hazardous materials they need to be shipped accordingly. Check with the courier for specific shipping, labeling and packing requirements.

REFERENCES

SOP No. 6827: Packing and Shipping of Samples.

U.S. Environmental Protection Agency. NEIC Policies and Procedures. EPA-330/9-78-OO1- R. May 1978. (Revised February 1983.)

U.S. Environmental Protection Agency. User's Guide to the Contract Laboratory Program. Office of Emergency and Remedial Response. December 1986.

U.S. Environmental Protection Agency. A Compendium of Superfund Field Operations Methods. EPA/540IP-87/OO1, December 1987.

Figure 1. Example of a Chain-of-Custody Record Form

AR100408

SOP-6827
STANDARD OPERATING PROCEDURE
PACKAGING AND SHIPPING OF SAMPLES

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used to package and ship all non-hazardous samples. These procedures are the recommended handling procedures for all sample shipments to minimize the loss of samples associated with breakage and/or being received above the method required temperature. These requirements are mandatory for all samples being transported by project personnel. Project personnel include all employees as well as personnel directly employed by the analytical subcontractor. Third-party courier services, regardless of whether contracted internally or by the analytical laboratory, are always considered non-project personnel. Strict adherence to these procedures shall help ensure sample integrity even if delivery is delayed.

2.0 EQUIPMENT AND MATERIALS

- Duct tape;
- Clear packing tape;
- Custody seals (see attached Figure 1);
- Ziploc (or equivalent) bags, various sizes;
- Packing material (Styrofoam, bubble wrap, etc.);
- Mailing labels (in addition to any shipping papers); and
- Site-specific Health & Safety Plan (HASP).

3.0 PROCEDURES

The following procedures shall be adhered to for packaging and shipping of all non-hazardous samples.

3.1 COOLERS

Coolers are the most common package or containment device used to ship samples. Coolers are also used during sampling efforts to store and transport samples prior to shipping. It is very important that samples be placed in an iced cooler immediately after collection. The ice in the cooler used for shipping will

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STANDARD OPERATING PROCEDURE
PACKAGING AND SHIPPING OF SAMPLES

last much longer if the sample containers placed into it have been pre-chilled. The following procedures shall be used when packing the cooler for shipment:

1. Secure the drain on the cooler with packing tape or duct tape to prevent accidental opening.
2. Place each individual sample (soil and/or ground water) in a Ziploc bag. VOA vials that are aliquots from the same sample can be placed in the same bag. It is recommended that the VOA vials be wrapped with bubble wrap or paper towel to prevent excessive contact during shipping.
3. Place the samples into the cooler. Situate the sample containers so that they do not touch each other. This is very important for aqueous samples in glass containers as they are more prone to break.
4. Use plastic bubble wrap or Styrofoam peanuts as packing or filler material to prevent the samples from colliding and breaking during transportation. A thin layer of Styrofoam on the inside bottom of the cooler may help prevent breaking of the sample containers during transport. Avoid using shredded paper as packing material. If the paper becomes wet it will no longer be useful to prevent samples from colliding. Only a minimum amount of packing material should be used as these materials insulate the samples and prevent them from being properly chilled. Plastic sample containers or cardboard can be placed between glass containers. Bags of ice may also be used as packaging material between samples. Sample containers should be snug and not easily moved within the cooler.
5. Fill the cooler with ice. Ice should be double-bagged in Ziploc bags. Forty to fifty percent of the cooler capacity should contain ice in order to keep the samples cold during transport. If a commercial carrier such as FedEx or UPS is shipping the samples, it is best to use more ice in case delivery is delayed. Less ice may be used if the samples will be delivered by hand. As a rule of thumb, an average cooler with a capacity of approximately 48 quarts will require two to three, eight-pound bags of ice.
6. Place the chain-of-custody (COC) record in a Ziploc bag and tape it to the underside of lid of the cooler. If samples are packed in multiple coolers, the number of coolers should be marked on the COC record and a photocopy of the COC shall be placed in each cooler.

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STANDARD OPERATING PROCEDURE
PACKAGING AND SHIPPING OF SAMPLES

7. Tape the cooler shut to prevent accidental opening or potential leakage. Tape shall be placed around the entire perimeter of the lid and then around the body of cooler in two or three places. Do not tape down or otherwise restrict access to the cooler handles. Coolers used for shipping should not have any broken or missing handles.
8. Custody seals shall then be placed on the cooler to document the integrity of the shipping container. A minimum of two custody seals shall be placed on each cooler in a manner that the cooler cannot be opened without breaking the seal. Each custody seal shall be signed and dated by the person packing the cooler and the seals shall be covered by clear packing tape to prevent accidental loss or damage during shipping.
9. Affix a mailing label with the laboratory's address on the cooler. Apply clear tape over the address label to prevent accidental loss or damage during shipping. The label should be used in addition to any shipping papers required by carriers.

3.2

BOXES

Some samples do not require temperature control and may be shipped in boxes. The boxes should be sturdy enough to withstand rough handling. No liquids shall ever be shipped by box. Materials suitable to be shipped by box include:

- Air samples in summa canisters, air-tight gas sampling bags or other non-pressurized sample containers;
- Bulk asbestos samples; and
- Soil samples for geotechnical analyses.

These materials may be securely packed in a suitable box. The box shall be sealed with packing tape and affixed with address labels and custody seals as described above.

4.0

DOCUMENTATION

A copy of any applicable shipping papers shall be retained for future reference. Any pertinent shipping information should be recorded on the Daily Field Report or in the field notebook for the project.

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5.0 ***SPECIAL NOTES***

None.

6.0 ***REFERENCES***

None.

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Figure 1. Custody Seals



Custody Seal

DATE

SIGNATURE



Custody Seal

DATE

SIGNATURE



SOP-6828
STANDARD OPERATING PROCEDURE
FIELD NOTEBOOK

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used to prepare a field notebook when conducting field operations.

2.0 EQUIPMENT AND MATERIALS

- Field notebook;
- Indelible ink pens;
- Ruler; and
- Watch.

3.0 PROCEDURES

Field books will be maintained to document investigation related activities and will be bound with numbered pages. Sample collection forms, data loggers, and/or figures may also be used to record field information. At a minimum, the information recorded will include the following:

- Date, time, and meteorological conditions;
- Names of personnel involved in field activities;
- Health and safety briefing;
- Sampling methods and equipment employed;
- Testing procedures;
- Sketches or maps depicting sampling locations or relevant observations;
- Depth intervals of samples;
- Information on quality control/quality assurance samples (date, time, matrix, type of sample);
- Log of photographs taken.
- Sample number;
- Date and time of sample collection;
- Source of sample (well, stream, domestic well, field etc.);

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FIELD NOTEBOOK

- Purged well: type of equipment, purge volume, rate of purge, and decontamination procedures;
- Location of sample: include a site sketch and/or written description of where sample was obtained to permit relocation;
- Analysis and QA/QC required: EPA Method 601, 602, Metals, Tier I, Tier II, etc.;
- Chemical preservation used: HNO_3 , H_2SO_4 , NaOH , etc.;
- Field instrument calibration, including date of calibration, standards used and their source (lot number and expiration date), results of calibration and any corrective actions required;
- Field data: pH, DO, specific conductance, temperature, etc.;
- Field observations: significant observations will be documented, to include:
 - Sample conditions (color, odor, turbidity, oil, sheen), or
 - Site conditions (stressed vegetation, exposure of buried wastes, erosion problems, etc.);
- Sample shipment: date, time and destination, and whether legal seals were attached to transport container(s); and,
- Comments: any observations or events that occurred that would be relevant to the Site or the resulting data use; for example, weather changes or the effect it had on sampling, conversations with third parties, instrument calibration, equipment problems, etc.

4.0 DOCUMENTATION

The documentation is as described above, consisting of a field notebook with field notes and observations as well as sample collection forms and/or figures that will be referenced in the field notebook.

5.0 SPECIAL NOTES

When a mistake is made on the log, a single line crossing through the entry is made in ink, and the correction should be initialed and dated.

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STANDARD OPERATING PROCEDURE
FIELD NOTEBOOK

6.0

REFERENCES

None.

SOP-6830
STANDARD OPERATING PROCEDURE
AQUIFER TESTING - SINGLE WELL TESTS

1.0 PURPOSE

The purpose of this SOP is to describe the procedures that shall be used while conducting slug tests and specific capacity tests as part of aquifer testing. These procedures are recommended for use during the conduct of all slug and specific capacity tests thereby providing uniform testing procedures and more accurate and consistent results. The selection of the appropriate test method will depend upon a number of parameters including, but not limited to - depth to water inside the well, volume of water in the well and recharge rate to the well.

2.0 EQUIPMENT AND MATERIALS

2.1 SLUG TESTS

- Well construction log for the test well;
- Tape measure;
- Water pressure transducer;
- Computer with appropriate software;
- Slug of known volume;
- Watch or stopwatch;
- Decontamination equipment;
- Depth to water meter;
- Field notebook; and
- Site-specific Health & Safety Plan (HASP).

2.2 SPECIFIC CAPACITY TESTS

- Well construction log for the test well;
- Tape measure;
- Peristaltic or submersible pump;
- Watch or stopwatch;
- Container with graduated volume measurements (ideally in milliliters);

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AQUIFER TESTING - SINGLE WELL TESTS

- Decontamination equipment;
- Depth to water meter;
- Field notebook; and
- Site-specific HASP.

3.0 PROCEDURES

3.1 SLUG TESTS

A slug test involves the instantaneous injection or withdrawal of a volume or slug of water or solid cylinder of known volume. This is accomplished by displacing a known volume of water from a well and measuring the artificial fluctuation of the groundwater level. The following procedures shall be adhered to while conducting all aquifer slug tests:

- Measure initial water level on monitoring wells in an upgradient to downgradient sequence to determine the static water level. This information should be entered into the data-logger. Wells should be tested from least contaminated to most contaminated.
- Install the transducer and cable in the well to a depth below the target drawdown estimated for the test but at least two feet from the bottom of the well. Then connect the transducer cable to the electronic data-logger and record the initial water level on the recording device.
- Instantaneously introduce or remove a known volume or slug of water (or a solid cylinder of known volume) to the well.
- At the moment of volume addition or removal assigned time zero, measure and record the depth to water and the time at each reading. Depths to water should be measured to the nearest 0.01 foot following a logarithmic time scale.
- Continue measuring and recording depth-time measurements until the water level returns to equilibrium conditions or a sufficient number of readings have been made to clearly show a trend on a semi-log plot of time vs. depth.

Note that the time required for a slug test to be completed is a function of the slug volume, the hydraulic conductivity of the formation and the type of well completion. The slug volume should be large enough as to allow for a sufficient

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STANDARD OPERATING PROCEDURE
AQUIFER TESTING - SINGLE WELL TESTS

number of water level measurements before the water level returns to equilibrium conditions. The length of the test may range from less than a minute to several hours.

If the well used during the slug test is to be used as a monitoring well, precautions should be taken that the wells are not contaminated by material introduced into the well. Any water introduced into the well should be from an uncontaminated source. Bailers or measuring equipment should be cleaned prior to the test and precautions should be taken such that any contamination is not spread between wells during the slug test.

3.2

SPECIFIC CAPACITY TESTS

In-situ hydraulic conductivity tests can be performed on the selected monitoring wells to provide data for assessing the hydraulic conductivity of the aquifer. Prior to conducting the test in each well, the static water level should be measured using an electronic water level indicator. In-situ hydraulic conductivity tests are performed by pumping the well at a selected rate or drawdown and determining the well yield.

The tests are conducted as follows (Wilson, Cho, Beck and Vardy, 1997):

- Insert a 0.25-inch inside diameter polyethylene tube into the well with the tip at an elevation 0.5-foot (15 cm) below the static water level.
- Use a peristaltic pump to purge water from the well at a rate that produces both water and air. Depending on the flow rate and observed drawdown in the well the tube should be raised or lowered in three inch increments to achieve the correct water and air mixture. The well will then pumped until the flow rate comes to equilibrium and the time to collect 200 mL is measured. If the yield is very slow, the yield in five minutes should be measured.
- Alternatively, a submersible pump may be used to pump the well at a specified flow rate (e.g., 500 mL/min). Once equilibrium is reached, the level of drawdown can be measured.
- Specific capacity is calculated in milliliters per second per centimeter of drawdown. The specific capacity is multiplied by an empirical calibration factor, α , to estimate hydraulic conductivity in centimeters per second (cm/sec).